SCIENCE

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE SOCIETY FOR PLANT MORPHOLOGY AND PHYSIOLOGY.

THE fifth regular annual meeting of this Society was held at Columbia University, New York City, December 31, 1901, and January 1, 1902, under the presidency of Dr. Erwin F. Smith. There was a good attendance of members, and the meeting was in all ways successful. Friendly greetings were exchanged by telegraph with the botanists in session at Chicago. Some business of general interest was transacted, of which a full account will be found below. This included action upon the report on the *Botanisches Centralblatt* and the Association Internationale des Botanistes, the nomination of American members of the executive committee of the Association Internationale, and the report on the College Entrance Option in Botany. The following new members were elected: Miss Margaret Ferguson, Wellesley; Messrs. Ernst A. Bessey, Washington; T. E. Hazen, St. Johnsbury, Vt.; A. S. Hitchcock, Washington; C. F. Hottes, Urbana, Ill.; E. C. Jeffrey, Toronto; and R. H. True, Washington. The following officers were elected for the ensuing year: President, Professor Volney M. Spalding, University of Michigan; Vice-President, Professor Byron D. Halsted, Rutgers College; Secretary-Treasurer, Professor W. F. Ganong, Smith College. The Society will meet next year with the other societies at Washington.

On the afternoon of January 1 the Society adjourned to the New York Botanical Garden at Bronx Park, where the museums, laboratories and collections of living plants were shown by members of the Garden staff, and Professor MacDougal exhibited some new appliances developed in connection with his physiological work.

Among the enjoyable social features of the meeting were the luncheon given to the Society and its guests at the Teachers College by Professor Lloyd, and the very pleasant informal dinner of the botanists on Wednesday evening. The hospitality of the New York botanists to the members of the Society and their guests was most cordial, and contributed greatly to the pleasure and profit of the meeting. A group photograph of the Society was taken, resulting in an excellent picture, concerning the cost and other particulars of which information will be furnished by the secretary.

The address of the retiring president, Dr. Erwin F. Smith, was delivered at the dinner. It dealt with 'Plant Pathology, a Retroprospect and Prospect.' It will soon appear in full in Science.

The following papers and reports were presented and discussed. Owing to the crowded condition of the program at the preceding meetings, papers were accepted this year from members and nominees to membership only. The abstracts are prepared by the authors.

Artificial Changes affecting the Vegetation of the Huron River: Professor V. M. Spalding, University of Michigan.

In the course of a botanical survey of the Huron river and valley it has been found that artificial changes induced by the erection and breaking down of dams have been followed by rapid and extensive readjustment and adaptation. Changes of water level and rapidity of current are responsible for some of the most striking phenomena. Several species, among them *Polygonum emersum* and *Solanum Dulcamara*, exhibit remarkable plasticity, and their structural changes are such as enable them to play the part of aquatics or of land plants as the raising or lowering of the water level may require. Charts are being constructed to show the present distribution of the various plant societies of the river and valley in the vicinity of Ann Arbor.

A Floating Tropical Botanical Laboratory: Dr. John W. Harshberger, University of Pennsylvania. (Illustrated.)

The West Indies, lying in close proximity to the United States, are easily accessible to American botanists. By means of lantern slides, a few of the possible lines of research work, suggested on a visit to the Bahamas, Haiti and Jamaica during the summer of 1901, were illustrated. It was suggested that an investigation of the mature bending of the trunk of the coco-nut palm, of the pollination of the West Indian grown figs (*Ficus*), of the ecologic relationship of the plants of the strand, of the xerophytic and mesophytic forests, might be undertaken with profit. As many of the islands have an irregular coast line, are somewhat inaccessible, and as the inhabitants of Haiti look with suspicion upon strangers, it was thought advisable in investigating the flora of the various islands to visit them by means of a steamer fitted up as a tropical research laboratory. The steamers, Norwegian built (such as the *Belvernon* and *Mt. Vernon* of the Cameron Line), cut away fore and aft, were thought best adapted for the purpose.

The Physiology of Sea Water: Dr. Rodney H. True, Department of Agriculture.

The studies reported were made at

Wood's Holl, Mass., during portions of the last three summers. The plant most used was *Cladophora gracilis*. This alga was able to survive temporarily in a cane-sugar solution containing 1.2 gram molecules per liter of solution without apparent injury, and carried on its functions with seeming regularity. A greater or less proportion of the cells lived in concentrations between 0.3 grm. mol. and 1.6 grm. mol., but at the extremes unbalanced osmotic forces wrought injury to the younger cells. The plants were fatally affected within an hour by solutions of sodium chlorid in all concentrations, and in a solution isotonic with sea water were unable to respond to plasmolytic tests after about one-half hour. A progressive synthesis of artificial sea water, containing those substances present in a quantity equal to five thousandths of one per cent., was made. Death in a solution containing the proper amount of sodium chlorid took place in about a half-hour. When to this magnesium salts were added, no marked change in the period of survival was seen. The addition of the trace of calcium sulfate required extended the time of survival to about two hours. On the further addition of the potassium compounds, the plants lived for about twenty-four hours. Although isotonic with natural sea water, this artificial mixture was less saline to the taste than the former. On adding further sodium chlorid (about three-fourths per cent.) until equal salinity to the taste was obtained, the artificial solution was found to be capable of supporting an apparently normal existence in the alga for eight days. Evidence that cannot be summarized here was presented in support of the view that not only the actual amount of substances dissolved is concerned in the physiological behavior of sea water, but that the form in which these things there exist is important. Further work is in progress.

On the Teaching of Plant Physiology to Large Elementary Classes: Professor W. F. GANONG, Smith College.

The author called attention to the fact that the advance of science depends not only upon the acquisition of new knowledge and its correct interpretation, but also upon its utilization, of which one phase is its application in education. Plant physiology is rapidly rising in educational favor, but a chief obstacle to its more rapid advance is the difficulty of teaching it to large classes by proper laboratory methods. It was pointed out that many of the practical difficulties are disappearing with the improvement in methods and appliances, and ultimately the subject will be taught through individual experimentation. This is not yet practicable in large elementary classes, and at present students must be taught *en masse*. After trial of various plans the author had attained fair success by selecting the ten or twelve most fundamental experiments and setting them up, with full explanations, before the class, requiring the students individually to make records and finally to present reports upon them. The details of the management of the plan on which its success largely depends can not be repeated here, but the paper is soon to be published in *School Science*.

Discussion on the Most Profitable Relation of the American Botanical Societies to one another.

The opinions brought out by this discussion agreed very closely with those expressed by the speakers before the American Society of Naturalists at Chicago on January 1, as reported in this journal for February 14. One speaker urged a closer union of the various societies with the American Association, while another advocated the merits of a double system, in which regional societies, meeting regularly

in the principal centers within natural geographical districts, would combine with the American Association whenever the latter meets within their territory, the American Association thus forming a bond between the various regional societies.

Report of the Committee on the Botanisches Centralblatt, presented by the Chairman, Professor W. G. Farlow, Harvard University.

Printed copies of the report were distributed to those present. It showed a completely successful result of the committee's work. A full account of this report and its bearings will be given elsewhere in this journal, so that for the present it is enough to say that it describes the continuance of the correspondence with the proprietors of the *Botanisches Centralblatt* authorized by the Society last year, the purchase of the *Centralblatt* by the Association Internationale des Botanistes, and the selection of the seven American editors of the journal. The committee having completed its work was discharged with the thanks of the Society. Professor Farlow explained further the present status of the *Centralblatt* as the organ of the Association Internationale, and the business features of the arrangement. Membership in the Association is open to any one interested in botany, on payment of the annual subscription of 25 shillings, and all members will receive the *Centralblatt* free. To meet the purchase price of the *Centralblatt* one hundred bonds have been issued of the value of 250 florins each ($100.68), subscription to one or more of which makes one a foundation member of the Association. These bonds bear interest at the rate of 2½ per cent. and are to be redeemed from the profits of the *Centralblatt*. Very few have yet been taken in this country, and it is desirable, in order that this country may do its share in this important matter, that more should be taken here. The *Centralblatt* promises to be a strong journal of reviews, indispensable to every botanist, and it now has the support of the leading botanists of the world. In the discussion which followed, it was pointed out that American members of the Association Internationale would soon be called upon to vote for two American members of the general executive committee of the Association. There appears to be no body of botanists with authority to make nominations of such members, although in the absence of nominations the votes are likely to be very scattering or even not cast at all. It was then suggested that, in view of the fact that this Society had managed the correspondence with the proprietors of the *Centralblatt* and had aided the Association Internationale to choose American editors, etc., it might not be inappropriate for the Society also to suggest nominations of American members of the executive committee. Accordingly the Society voted to thus suggest the nomination of Professors W. G. Farlow and C. E. Bessey. Professor Farlow stated that he would be unable to serve on the committee, and accordingly Professor W. F. Ganong was nominated instead. It was announced that any further information about the subject, copies of the report of the committee, or of the blank forms of application for membership in the Association or for subscription to bonds, could be obtained from Professor Trelease, Missouri Botanical Garden, St. Louis, Mo., chairman of the American Board, or from the secretary of the Society.

On the Teaching of Vegetable Pathology: Dr. Hermann von Schrenk, Shaw School of Botany.

The speaker discussed the scope of vegetable pathology and urged the necessity of recognizing the plant as a living organism. For a course of vegetable pathology, a

thorough knowledge of physiology, general chemistry (preferably also organic chemistry), physics, general morphology of higher plants, French and German ought to be required. He outlined a course in pathology beginning with the study of the influence of environmental conditions on the plant cell, followed by actual experimental work with bacterial and fungous diseases. Emphasis was laid upon the fact that the plant should be considered first and foremost, and that the student should work with this himself.

The Destruction of Cell Walls by Bacteria: Dr. ERWIN F. SMITH, Department of Agriculture.

Lantern slides were exhibited showing all stages in the destruction of the inner tissues of the turnip due to the parasitism of *Pseudomonas campestris.* All were made from one plant which was inoculated on the blades of the leaves by means of needle pricks, using a pure culture of this bacterium. The disease appeared on the leaves only after a number of days. There was a progressive downward movement of the disease. The plant was removed from the soil on the fifty-second day after inoculation, at which time most of the leaves were shriveled, but the root was white and entirely sound externally. Sections of the root showed the bacteria to be very abundant in the inner parts. A careful microscopic examination made at the time did not reveal the presence of any fungi or animal parasites in the tissue. Cultures made from the interior of this root yielded only *Pseudomonas campestris.* Portions of the root were fixed in strong alcohol and subsequently infiltrated with paraffin, cut on the microtome with a very sharp knife, and fastened to slides with water containing one-half per cent. gelatin, freshly prepared. The paraffin was subsequently dissolved out with turpentine, the sections stained in carbol-fuchsin, washed in water containing 50 per cent. alcohol, passed through graded alcohols, dehydrated in absolute alcohol, passed into xylol and finally mounted in Canada balsam. A study of serial sections with the best microscopic appliances has failed to reveal the presence of any fungi in the sections. The parts which are attacked are only the inner parts of the root (vessels and parenchyma). Many of the bundles are filled with the short bacterium, and cavities in the parenchyma are found around some of these bundles. The fixing and subsequent treatment of the sections allow the study of the organism *in situ.* The bacterial masses are not torn or displaced by the knife, and an examination of these slides shows all stages in the solution of the cell walls, from single cells or vessels occupied by the bacteria, to cavities occupying the place formerly occupied by hundreds of cells and filled with the bacteria and the remnants of the cell walls. The cells are crowded apart by the growth of the bacteria, and the middle lamella first disappears, but the cell walls proper also become vague in outline and finally disappear.

Observations on the Bacterial Rot of the Calla Lily: Dr. C. O. TOWNSEND, Department of Agriculture.

This is a soft brown rot, with offensive odor, that usually attacks the bulbs but may appear on the roots or leaves. It has been observed to destroy the calla plants in entire houses in the vicinity of Washington. As a rule, the bulb shows the disease most frequently near the top, but it often happens that the attack is made below the surface of the ground, in which case the bulb is commonly almost entirely destroyed before the leaves indicate that the plant is diseased. If proper conditions prevail, the disease progresses rapidly and the diseased tissue is broken down. Agar

plate cultures, made with care from the advancing margin of the diseased area, give only bacteria and generally pure cultures of a rod-shaped motile Schizomycete. Neither fungi nor burrowing insects are present. The colonies appear in the agar plates in from twenty-four to thirty-six hours. The surface colonies grow rapidly, are nearly round, slightly convex, having a milky color, shining surface and entire margin. The imbedded colonies remain much smaller, are mostly spindle-shaped and have a brownish tinge. The organism grows rapidly on nutrient, slant agar, and on steamed potato, carrot, parsnip, salsify, beet and onion. It does not discolor the medium upon which it grows; it develops slowly in alkaline gelatin; the stab cultures are beaded in form, and the gelatin is not liquified. Milk is coagulated rather rapidly; blue litmus milk is changed to red and eventually faded to white. Nitrates are reduced to nitrites. The organism grows in the closed end of fermentation tubes containing peptonized beef bouillon with 5 per cent. grape sugar, but without formation of gas. Diseased plants have been treated with lime, sulfur and dilute formaline, with some success in controlling the disease, but the best treatment found thus far consists in changing the soil in the calla bed or in growing the plants in pots, and in the proper management of the greenhouses.

A Disease of the American Ash: Dr. Hermann von Schrenk, Shaw School of Botany.

A disease of *Fraxinus Americana* caused by *Polyporus fraxineus* was described. Attention was called to the large per cent. of living trees affected with this disease in localities where the ash is present in large numbers.

Vegetative Reproduction in Leptolejeunea: Professor A. W. Evans, Yale University.

Certain species of the epiphyllous genus *Leptolejeunea* reproduce themselves largely by means of leafy propagula, which represent modified branches. This type of vegetative reproduction, although known in several mosses, has not before been recorded for the hepatics. The first leaves and under leaves of the propagula show curious modifications, and the most remarkable of these are found in the underleaves, which develop disc-shaped suckers instead of the usual clusters of rhizoids. By means of these suckers, the propagula are able to attach themselves quickly to the smooth leaf-surface upon which they grow.

Observations on Pterygophora: Professor Conway MacMillan, University of Minnesota. This paper will be published in full in *Minnesota Botanical Studies.*

Pterygophora grows much larger in the Straits of Fuca than reported in systematic works upon the kelps. It has been found with stipe three meters in length and a decimeter in thickness. Secondary thickening, in *Lessonia* apparently limited to the stipe, takes place in *Pterygophora* in both hapteres and stipe, producing rings of growth in each of these organs. Secondary thickening in the haptere differs from that in the stipe. In the former the ringed appearance is principally due to succession of cell layers differing in contents; in the latter the ringed appearance is due to succession of cell layers in which the elements are of different size and shape. A cross section through the growth-ring in the stipe of *Pterygophora* recalls similar sections through the stem of Gymnosperms. The substance which by its varying abundance in successive cell layers gives rise to the ringed appearance in cross sections of old hapteres is related to that which has been called fucosan and appears to be polysaccharid in character. Pits, in the strengthening tissue and tissue of growth-rings of the stipe, are abundant upon the

concentric faces of the tracheid-like elements, but are generally absent from the radial faces. Mucilage canals announced for this plant by Ruprecht are wanting. An abundant formation of polysaccharids goes on in old pinnæ and hapteres. *Pterygophora* differs strongly in its anatomical structure from *Lessonia*. The secondary thickening differs anatomically from that of other kelps studied. A series of young plants, from 2 cm. in length, shows that the midrib is basally developed in the principal lamina and that it is not present in the younger stages. In this respect *Pterygophora* strongly differs from *Alaria*. The classification of *Pterygophora* in the vicinity of *Alaria* is of somewhat doubtful value. It appears rather to be a genus of Laminarieæ and may be related with such a form as *Laminaria radicosa* Kjellman.

Germination of Basidiomycetous Spores: Dr. MARGARET E. FERGUSON, Wellesley College.

This investigation was undertaken to determine, more definitely than is known at present, the conditions of germination in the Basidiomycetes, particularly in *Agaricus campestris*. Twelve species out of the twenty-six studied in preliminary tests yielded high percentages of germination in various media, and four species gave fifty per cent. germination or less. The spores of eleven species germinated in distilled water, but the percentages of germination were invariably lower than when an external food supply was present. The effect, on the germination of the spores of *Agaricus campestris*, of extremes of temperature, alkalies, acids, and organic substances was tested. The spores were also subjected to the action of an artificial digestive fluid. The percentages of germination obtained in these experiments with *Agaricus campestris* varied from 0 to 25. Almost perfect germination of the spores of this species was, however, obtained in a large number of cultures and in various media; but a high percentage of germination never occurred except in cultures containing the growing mycelium of *Agaricus campestris*. The germinated spores were frequently transferred to test-tubes containing bean stems and other solid substrata, and in many instances abundant mycelium was produced. A full report of these studies, which were undertaken at the suggestion of Professor B. M. Duggar, is now in the hands of the publishers and will appear shortly.

Behavior of Mutilated Seedlings: Professor BYRON D. HALSTED, Rutgers College. (By title.)

The particular form of mutilation of seedlings here considered is that of the removing of the plumule. In radish seedlings the first change noticed was the deeper green of the cotyledons, followed by a remarkable elongation of the petioles. The cotyledons became thicker than in those of the normal plants, due to increase in size of cells, and filled with starch, while the roots grew to considerable size. In the morning glory a similar behavior of the cotyledons was observed, while the hypocotyls became enlarged and served as a repository for the large accumulation of starch. In the Hubbard squash the cotyledons of the deplumuled plants remained close to the earth and grew to four or more inches in length, and held green for over four months. The egg-plant as a type of a slow-growing seedling produced rigid upright cotyledons that became quite fleshy and remained alive for many months. The sunflower illustrates a type in which the hypocotyl elongates greatly until it is sometimes over nine inches in length, with the primitive structure retained. In other words, the ring of wood is not developed as in the normal plants. These experiments illustrate how

an organ normally designed to store food for the developing seedling may persist in an emergency and take on a greatly increased size for that purpose. The petiole may assume a direction in connection with its enlargement that will aid the blade in its work of photosynthesis. Along with these changes in the seed leaves there may be others in surrounding parts, particularly the hypocotyl which becomes thickened remarkably and green in the morning glory and greatly elongated but slender in the sunflower. In the radish a place for any surplus growth still remains, for the root is naturally destined to be fleshy and the hypocotyl is not modified.

Notes on New Species of Lichens collected by the Harriman Expedition: Professor Clara E. Cummings, Wellesley College.

The list, soon to be published, contains an enumeration not merely of the species collected by the members of the Harriman expedition, but also of various other collections, notably that made by Professor Setchell in Alaska the same year. The total number of species and varieties listed is 219. Of these 97 species are new to Alaska, three of which are new to America and three others new to science. The three new species were referred provisionally to the genera *Verrucaria, Endocarpon* and *Pertusaria*. The Verrucaria was said to be characterized by an unusual development of the thallus. Three points of difference from the typical *Endocarpon* were noted, namely the distribution of the gonidia throughout the tissue of the thallus, the numerous perforations in the mature prothallus and the projection of the apothecia beyond both surfaces of the thallus. In further discussion the possibility was suggested that new genera might perhaps be established for the so-called *Verrucaria* and *Endocarpon*.

What is the Archesporium? Professor F. E. Lloyd, Columbia University.

It is proposed to limit the use of the term 'archesporium' to the mass of cells which, by tetrad divisions, gives rise to spores. The cells heretofore so designated have diverse origins and no peculiar morphological features, and are distinguishable only by their denser cytoplasmic contents. They are vegetative cells which are set aside when an extensive archesporium is necessary. It is only when the constituent cells enter the heterotypic mitoses that their peculiar character is without doubt evident. In parthenogenetically reproduced plants where true tetrad division in this sense lapses, the archesporium is determined on comparative grounds.

The Continuity of Protoplasm: Dr. Henry Kraemer, Philadelphia College of Pharmacy. (By title.)

The earlier studies of the author upon the structure of starch grains showed under certain conditions the presence of radiating feather-like clefts, which he concluded represented channels through which liquids are distributed throughout the grain. Studies with similar reagents upon cell walls seem to imply a similar nature for many markings which have commonly been explained as passages for permitting the continuity of protoplasm from cell to cell. He calls attention to references to the use of sulphuric acid in the study of continuity of protoplasm, and the objections to its employment for this purpose. The studies are being continued.

The Embryology and Germination of the Genus Peperomia: Professor Duncan S. Johnson, Johns Hopkins University.

The ripe seed of this genus is about .5 mm. long; the globular, fifteen-celled embryo only .04 mm. and the surrounding endosperm .1 mm. in diameter. In germination the endosperm bursts out of the

seedcoat at the tip but continues, as a jacket two cells in thickness, to enclose the embryo till the latter, after reaching a size of .15 mm. as a globular, undifferentiated mass of cells, at length develops two cotyledons and a root, and the latter bursts through the endosperm and bends down to anchor in the soil. From the beginning of its development to the time when it drops, with the exhausted seed, from the tips of the highly elevated cotyledons the endosperm seems never to serve for the storage of food material, but always as a digesting and absorbing organ for dissolving and passing on to the embryo the starch with which the abundant perisperm is filled. This seems to be the sole function of the endosperm also in many other genera, especially those with abundant perisperm, *e. g., Saururus, Heckeria, Dianthus* and *Cerastium.*

Report of the Committee on the Standard College Entrance Option in Botany: Presented by the Chairman, Professor W. F. GANONG, Smith College.

The report stated that the option had been formulated by the committee, had been printed and distributed to members in April and had been widely circulated among prominent teachers. Notes calling attention to it had been inserted in SCIENCE and in *School Science* and had caused a demand which exhausted the edition of 200 copies. Taking into consideration the criticisms and suggestions received, the Committee (reduced to the chairman and Professor Lloyd by the withdrawal of Professor Atkinson) prepared a revised edition which was printed in June and distributed in October. As a whole, the replies to the request of the Committee for suggestions, etc., indicated a surprisingly wide approval of the features of the option recommended by the Committee. The adverse criticisms were practically only three. First, it was thought by some too difficult for a year of high school study. In answer to this it was stated that it was the intention to make it fully as hard as a year of any other subject whatsoever taught in the high schools. The time is past when botany should be content to occupy a humble corner in the high school curriculum. It may be offered or not offered, but if offered at all it must be upon a plane equal to that of any other subject whatever. Second, it was objected, though not widely, that it laid too much stress upon ecology, which was thought not to be a proper high school study. The general consensus of opinion, however, seems to favor some ecology in the high school course, though it should be only of the most concrete and definite sort, and it is this kind of ecology the Committee has endeavored to emphasize. Third, it has been held that the part dealing with the types of plants and groups should not proceed primarily, as the Committee recommends, from the point of view of natural history but from that of morphology. In answer to this the Committee points out that the one does not exclude the other, and that in order that the course may be equally available for the education of those who go no farther and for those who continue into higher courses, it seems best to approach the subject from that point of view which will have the most meaning for the average high school student, and which will yield him the knowledge of most pleasure and profit to him in after life. In the opinion of the Committee such a point of view is rather that of natural history than of comparative morphology, and the special comparative morphology of the groups can best be taken up in second courses by those who go on. It was reported that the option had been formally adopted by the College Entrance Examination Board, and would shortly be pub-

lished in one of their documents. This, together with the widely favorable criticism it has received, indicates that it will probably be widely adopted. The Committee recommended that a standing committee of two be appointed to take the further interests of the option in charge, to keep it in touch with educational progress, and readjust it to changing conditions; and that a new edition be prepared for distribution. The report was adopted, and as the committee, the former committee, Professors Ganong and Lloyd, was reappointed.

W. F. Ganong,
Secretary.

THIRD ANNUAL MEETING OF THE CORDILLERAN SECTION OF THE GEOLOGICAL SOCIETY OF AMERICA.

The Cordilleran Section of the Geological Society of America held its third annual meeting in the Academy of Sciences, San Francisco, on December 30 and 31, 1901. In the absence of the chairman, Professor W. C. Knight, of Wyoming, Mr. H. W. Turner was elected temporary chairman. The secretary reported the following rules as having been adopted by the Council of the Society at Denver, August 26, 1901:

1. *Officers.*—The officers of the Cordilleran Section shall be a Chairman and a Secretary. The latter shall also perform the duties of an accounting officer with reference to the expenses of meetings.

The officers of the Section shall be resident within the geographical limits of the Section. A President or Vice-President of the Society shall be, *ex officio*, Chairman of the Section whenever present at a meeting.

2. *Geographical Limits.*—For purposes of scientific fellowship and discussion the limits of the Section shall correspond with the limits of the general Society, and the meetings of the Section shall be open to all Fellows of the Society for presentation of papers, either in person or by proxy. For purposes of administration the membership of the Section shall be limited to those Fellows residing west of the 104th meridian.

3. *Membership.*—No person not a member of the Society may become a member of the Section. Members may invite contributions to the discussions at their meetings under the same rules as those applied to meetings of the Society.

4. *Date of Meetings.*—The meetings of the Section may be held at any time, subject to approval by the Council of the Society (Article 4 of Constitution). All notices and programs of meetings shall be sent to all Fellows of the Society.

5. *Expenses.*—The expenses of the Section, so far as they shall be paid from the general fund of the Society, shall be limited to the ordinary economical expenses of the meetings.

6. *Publications.*—All papers presented to the Section shall be available for publication in the *Bulletin* of the Geological Society of America under the rules governing publication by the Society.

The officers elected for the ensuing year were: H. W. Turner, of San Francisco, Chairman, and Andrew C. Lawson, of Berkeley, Secretary. An executive committee consisting of the chairman, secretary and Professor J. C. Merriam was appointed.

Resolutions were adopted expressive of the sense of loss sustained by the Section in the deaths of Professors Joseph Le Conte and E. W. Claypole.

The following papers were read and discussed partly in the Academy of Sciences and partly at the University of California, where the Section met after the opening session, for the purpose of viewing illustrative specimens and lantern slides:

An Instance of Variability in a Rock Magma: H. W. TURNER, San Francisco, Cal.

The instance referred to is the granolite area east of Sonora in Tuolumne County, California. This area is enclosed on three sides by the sedimentary rocks of the Calaveras formation, and on the east by a granite and gneiss series of older age, so that it is practically an enclosed area. The rock is designated, on the Sonora geological map of the United States Geological Survey, granodiorite, but it is not a typical example of that rock. It contains at most points some orthorhombic pyroxene. The rock varies from a granodiorite containing nearly 63 per cent. of silica to olivine gabbro containing about 43 per cent. of silica, there being all gradations between these extremes. The mass is intrusive in the Calaveras formation. The gabbro forms a hill in the interior of the area. The variation in mineral and chemical composition is not regarded as being due to absorption of material from the surrounding rocks, but to a differentiation during crystallization. On the west and south the Calaveras rocks contain much limestone, but the most basic facies of the rock, the olivine gabbro, is not near their contact. Moreover the limestone is not a magnesian limestone, and if we seek to explain the high lime content of the gabbro (14.27 per cent.) by an absorption of lime from the adjoining calcareous rocks, we are also brought to account for the high magnesia content (7.65 per cent.) of the gabbro from a similar source, and there are no magnesian rocks in the neighborhood outside of the granodiorite-gabbro mass, except small amounts of perknite or amphibole-pyroxene rock, and these are not, except at one point, in juxtaposition to the granodiorite-gabbro area. There perknites may indeed be themselves the extreme result of differentiation of the granodiorite. There are abundant dikes of diorite in the granodiorite, and pegmatite and quartz-tourmaline dikes or veins.

Triassic Reptilia from Northern California: JOHN C. MERRIAM, Berkeley, Cal.

Reptilian remains were first discovered in northern California in 1893, when Professor James Perrin Smith obtained two short series of vertebræ and two arch bones in the Triassic limestones. These specimens were described by the writer in 1895, under the name of *Shastasaurus,* and were thought to belong to a form closely related to the Ichthyosauria, though they did not appear to find a place in any known genus. During the summer season of 1901 a quantity of new material was obtained from the original locality. The collection includes considerable parts of five skeletons, also numerous loose limb-bones, vertebræ, ribs, etc. Nearly all of the specimens belong to the genus *Shastasaurus,* of which there are several well-characterized species. Two nearly complete series of dorsal and cervical vertebræ show *Shastasaurus* to be characterized by possessing single-headed ribs on all of the vertebræ in this region excepting the anterior 8–9. In the cervicals the parapophysis is relatively small and in the anterior dorsal region it disappears entirely. As far back as the middle dorsals the articular surface of the diapophysis is confluent with that for the reception of the upper arches. The anterior and posterior limbs have not been found together, but are known from species having the same type of vertebræ and ribs. The anterior limb is ichthyosaurian in type, but the transverse diameter of the humerus is much greater than the longitudinal. The radius and ulna are very short and are separated by a considerable space. In the posterior limb the femur resembles that of *Ichthyo-*

saurus. The tibia and fibula are longer than in that genus and are separated by a wide cleft. The anterior arch is ichthyosaurian excepting the scapula which is very broad. The posterior arch is very different from that of *Ichthyosaurus*. The skull is not well known. The dentition resembles that of *Mixosaurus*. The forms of this genus represent a distinct group of the Ichthyosauria. In some respects they are generalized and resemble *Mixosaurus*, in the other characters they show specializations which separate them from the other members of the family.

Ore Deposits of Shasta County: F. M. Anderson, Berkeley, Cal.

The copper belt of Shasta County, California, embraces, geologically, a series of old sedimentary rocks, Devonian, Carboniferous and Triassic, which extend in somewhat parallel bands northeasterly and southeasterly across the course of its longer axis. These strata have been penetrated and disturbed by intrusions of acid granolite, generally of the character of granite porphyry, though variable, which have been accompanied by flows of rhyolite and lavas resembling trachyte. In the vicinity of these intrusions and generally enclosed in the metamorphosed sedimentary rocks occur the deposits of sulphide ore which forms the subject of this paper. There are three or more types of ore represented among these deposits. The first class includes deposits found to the south of Pitt river near the mouth of the McCloud. They consist essentially of lenticular bodies of pyrrhotite carrying pyrite and chalcopyrite, but on the whole a low percentage of copper. These pyrrhotite bodies sometimes reach a thickness of 8 or 10 feet and a length of 50 or 60 feet, and are apparently connected with intrusions of dioritic rock. The second class of deposits is represented in all of the large ore bodies west of the Sacramento river, including the properties of the Shasta King, Balaklala, Iron Mountain and Mammoth mines. They are immense bodies of sulphide ore, consisting almost entirely of pyrite and chalcopyrite, with comparatively little zinc blende, but carrying both silver and gold. They appear to be replacement deposits, and have preserved in a measure the banded or stratified form of the original rocks. The largest of these deposits approximates 2,000,000 tons in extent. The grade of the ore varies from 1 to 20 per cent. in copper, averaging generally between 3 and 7 per cent., and carrying silver and gold to the value of $2.50 per ton. The ores of the Pittsburg and Afterthought districts, which constitute the third class, are similar to each other in character and probably in the mode of their occurrence. They are comparatively poor in iron and contain a larger percentage of zinc blende than any of the others. The ore includes little pyrite, consisting largely of chalcocite, bornite, chalcopyrite and other rich sulphides, with a gangue of silica and barite. The average grade of the ore at Bully Hill is nearly 10 per cent. copper with a relatively high value in silver and gold. The surface alteration in these deposits has resulted in the removal of the copper contents from the upper levels in which there is considerable concentration of gold and silver. In many cases the copper has found secondary lodgment in lower portions of the deposit, forming what is sometimes designated the 'copper level.' This secondary enrichment of the ore bodies is the rule throughout the whole extent of the copper belt. The grade and magnitude of these sulphide deposits entitle them to rank among the most important in the United States.

Lake Chelan, Washington: H. W. Fairbanks, Berkeley, Cal.

Lake Chelan is one of the most remark-

able and interesting bodies of fresh water in the west. It is situated in an ancient valley upon the eastern slope of the Cascade range in northern Washington. The lake has a length of about 60 miles and a width of one to two miles. It has an elevation of 950 feet above the sea level and a depth of about 1,400 feet. The country surrounding the lower end of the lake is quite open and contains numerous settlers, but through the greater portion of its length it is inclosed by mountains which rise quite precipitously 3,000 to 5,000 feet. The valley in which the lake lies has had an interesting history. It was occupied in quite recent times by one of the largest glaciers upon the eastern slope of the Cascade range. Previous to that there was another lake here, but at a somewhat lower level. The earlier lake was probably raised but slightly above the level of the Columbia river, into which it must have emptied. In the opinion of the author the great depth of the lake is due not to the erosion of the glacier, but to the fact that it was the bed of a stream, and was cut out chiefly by stream erosion. The glacier undoubtedly enlarged the valley somewhat and may have deepened it a little. If this view is the correct one the valley in which the lake lies must have been eroded at a time when the level of the land with respect to the ocean stood many hundreds of feet higher. The Columbia lava plateau would interfere with the drainage of such a valley, so that it must have been excavated prior to the formation of the plateau. The lake is held at its present level of 325 feet above the Columbia river, from which it is distant only three miles, by a morainal dam. The lower end of the lake is shallow, but as far as known to the author there is no reason to suspect that bedrock would be encountered at about the level of the Columbia river, which would be the case if the bed of the lake had been dug out by the glacier.

Lake Quiberis, an Ancient Pliocene Lake in Arizona: WM. P. BLAKE, Tucson, Arizona.

The San Pedro river of Arizona drains a considerable area, and is bordered throughout its course by mountain ranges forming a valley from ten to twenty miles in width and nearly one hundred and fifty miles in length. The valley is in general parallel with that of the Santa Cruz, the next great valley to the westward. A lake-like sheet of water of which we have good evidence filled the greater portion of this valley in late Tertiary or Quaternary time. This evidence is chiefly the presence on both sides of the valley of unconsolidated red clays and sediments in horizontal beds of great thickness, often terraced by the river erosion, and extending high up on the sides of the bordering mountains. One of the best cross-sections is found on the line of the Southern Pacific railway which crosses the valley nearly at right angles to its course at Benson. Benson, in the bottom of the valley, has an altitude of 3,576 feet above the sea. The river is about fifty feet lower. The lacustrine clays rise from this point on each side to the height of about 3,800 feet. The exact limit of clay deposition is not easily determined. It appears most probable that the height of the water was about 4,000 feet above tide. The sediments are similar to those around Benson, bordering the valley northwards, towards the Gila Valley. We there find also, in addition, the thick beds of diatomite mingled with fine volcanic ash. These diatoms are mostly marine species, according to Dr. D. B. Ward, of Poughkeepsie. But some fresh water forms are present. The Quiberis Valley thus appears to have been occupied by sea-water. It was open on the north to the great open valley of the Gila and Salt rivers and would appear to have existed as a partly landlocked estuary, at least in the upper portion between the

Dragoon Mountains and the Whetstones and Huachucas. The phenomena bear testimony also to the great epeirogenic uplift since the Miocene. A depression of four thousand feet would submerge the greater part of southern and southeastern Arizona, including the great valleys of the Gila river, Salt river and of the Santa Cruz, leaving only a few widely separated islands above the Pliocene Sea.

The Debris Fans of the Arid Region in their Relation to the Water Supply: E. W. Hilgard, Berkeley, Cal.

The debris fans or cones of the torrential periodic streams that enter the broad and deep valleys of the Cordilleran region are wholly different in their genesis and structure from the alluvial fans of the streams that enter lakes, as described by Gilbert (Monograph No. 1, U. S. Geol. Survey). Immediately in front of the cañon mouth we always find an accumulation of cobbles and boulders, the latter sometimes of enormous size; these grade off into smaller cobbles and gravel as the distance increases, but there is always an irregularly semi-elliptical area, of an extent proportioned to the size of the stream, on which the water is partly or wholly absorbed unless the discharge exceeds a certain amount, when a portion of it passes over the gravel area, carrying with it the finer materials, which are deposited beyond. As the valley is filled up and the slope decreases, it takes exceptional floods to carry the coarse materials to any great distance from the cañon mouth. Yet while the slope was steep and the valley channel relatively narrow, the cobbles were often carried to considerable distances. The water so absorbed in the coarse materials forms a pressure column behind the main body of the fan, which when large becomes a prolific source of artesian water, as is prominently exemplified in the upper San Bernardino valley and elsewhere in California. The extreme irregularity of structure within the fan, and the variations in the quantity and course of the main discharge of the stream, cause corresponding irregularity in the flows and static pressures of wells; high pressure being frequently coincident with small flows, and vice versa. Spontaneous outflows also frequently occur in times of high floods, or as the result of erosion on the fan slope. 'Artesian' springs and streams thus formed are important sources of irrigation water in southern California; they respond to the variations of the seasonal rainfall in from three to six months. Hence these debris fans form natural storage and regulating reservoirs of great importance. A striking example of the effect of these conditions upon the topography and hydrography of the valleys is afforded by the debris fan of San Antonio creek, a snow-fed torrent descending from the Sierra Madre northward of Pomona, Los Angeles County. Its typically regular fan has extended clear across the valley (nine miles) to the foot of the hills opposite, thus forming a water-divide between the Santa Ana and San Gabriel rivers. The creek itself has in the past evidently discharged alternately into the two drainage basins, which originally were probably a single one draining through the Los Angeles plain into the sea. This is an easily verifiable illustration of the manner in which the broad Cordilleran valleys have been filled in, as lately discussed by Shaler. Similar though less obvious examples exist in the Great Valley of California, as well as in the Santa Clara valley on San Francisco Bay.

A Post-Tertiary Elevation of the Sierra Nevada shown by a Comparison of the Grades of the Neocene and Present Tuolumne Rivers: H. W. Turner, San Francisco.

The Neocene Tuolumne occupied the

same drainage basin and followed approximately the same course as the modern stream. The most western point where the gravels of the Neocene Tuolumne have been preserved is east of the head of Big Humbug Creek in the Sonora quadrangle, and the most eastern Piute Canyon in the Yosemite quadrangle. If we now calculate the average grade of the Tertiary stream between these two points, and the average grade of the present river between the same points, we can compare the grades of the two streams. The altitude of the Neocene Tuolumne gravels at Big Humbug Creek is about 2,800 feet, and at Piute Canyon 7,500 feet, giving a difference of 4,700 feet. The altitude of the present Tuolumne north of Big Humbug Creek is 1,500 feet, and at Pate Valley, at the mouth of Piute Creek, 4,550 feet, giving a difference of 3,050 feet. The horizontal distance between the two points is about 33 miles. Assuming that both the Neocene and the present streams took a direct course, we have a grade of 142 feet to the mile for the Neocene channel, and a grade of 92 feet to the mile for the present channel. While the Neocene river occupied a rugged canyon, nevertheless this canyon was much less deep and rugged than that of the present Tuolumne, which implies, other things being equal, a higher grade for the present than for the Neocene channel, while, as we have seen, the reverse is the case. The broad channels and large sand and gravel deposits of the Neocene streams of the Sierra further north can scarcely be explained on any other hypothesis than of comparatively gentle grades, indicating an old age for the streams, and this must have been likewise true of the Neocene Tuolumne, although in less degree. Assuming that the Neocene Tuolumne had originally a grade at least as low as that of the modern stream, which is evidently yet a young stream, it is clear that the present grade of the Neocene channel must have been brought about by a differential uplift on the east, resulting in a tilting of the range westward.

On an Orbicular Gabbro from San Diego County, California: ANDREW C. LAWSON, Berkeley, Cal.

The rock described in this paper is a very basic gabbro in the form of an aggregation of spheroids having both radial and concentric structure. The spheroids have an average diameter of about 6 centimeters, but are mostly somewhat deformed in shape. The core of these spheroids is a granular gabbro and the space between the spheroids is of a similar character. An analysis of the rock is given.

A Geological Section of the Middle Coast Ranges of California: ANDREW C. LAWSON.

The paper is an attempt to summarize recently acquired information as to the sequence of formations and their respective volumes of sediments in the Middle Coast Ranges of California. The results given for the thickness are approximations sufficiently close to afford a general idea of the section. Other features of the paper are the subdivision of the Franciscan into seven stratigraphic subdivisions by the recognition of a persistent horizon of foraminiferal limestone and two important horizons of radiolarian chert; a similar subdivision of the Monterey into seven stages and a summary announcement of the character and history of the post-Monterey Tertiary. The essential features of the paper are given in the following tabulation.

The Pleistocene Ecology of Southern California: RALPH ARNOLD, Stanford University, California.

A summary statement of the marine Pleistocene of San Pedro and other localities of southern California with a subdivision of the Pleistocene formations partly on the basis of structural unconformities

GEOLOGICAL SECTION OF THE COAST RANGES OF CALIFORNIA IN THE VICINITY OF THE BAY OF SAN FRANCISCO.

			Thickness. Feet.
Merced	Upper marine sandstones, sandy shales and clay shales Lower marine clays, sandy shales, sandstones, fine pebbly conglomerates		5,830
	Unconformity.		
Campan	Volcanics, andesites, basalts, rhyolite agglomerates Fresh water, conglomerates, sandstones, clays, limestones		500
	Unconformity.		
U. Berkeleyan	Volcanics, basalts and tuffs Siestan, fresh water, clays, limestones, sandstones, shales, lignite, tuffs, conglomerates, Volcanics, andesites, basalts, rhyolite tuffs		200
	Unconformity.		
L. Berkeleyan	Volcanics, andesites, basalts, rhyolite tuffs		
	Trampan, marine shales, sandstones, pebbly conglomerates		2,000
	Orindan, fresh water conglomerates, sandstones, clays, limestones, tuffs		2,400
Pinole—Tuffs (pumiceous) fossiliferous			1,000
San Pablo—Blue tuffaceous sandstone, marine			1,500
	Unconformity.		
Monterey	Upper	Stage 7—Sandstone	1,800
	Middle	Stage 6—Bituminous shale	670
		Stage 5—Sandstone	1,200
		Stage 4—Bituminous shale	460
		Stage 3—Sandstone	600
		Stage 2—Bituminous shale and chert	250
	Lower	Stage 1—Sandstone	400
	Unconformity.		
Karquinez	Tejon—Massive sandstones		2,100
	Martinez—Massive sandstones		2,200
	Rhyolite flows. (Age not certainly determined).		
	Unconformity.		
Shasta-Chico	Chico—Sandstones and shales		3,000+
	Oakland—Conglomerate		500
	Peridotite irruptions.		
	Knoxville—Shales with subordinate limestone and conglomerate		1,000
	Unconformity. Volcanics.		
Franciscan	Bonita sandstone		1,400
	San Miguel cherts, radiolarian		530
	Marin sandstone		1,000
	Sausalito cherts, radiolarian		900
	Bolinas sandstone (volcanics)		2,000
	Volcanics.		
	Calera limestone, foraminiferal		60
	Volcanics.		
	Pilarcitos sandstone		790
			34,290

Unconformity.

Montara granite (correlated tentatively with late Jurassic granite of Sierra Nevada).

and partly on the basis of their fossil fauna.

A Contribution to the Petrography of the John Day Basin: F. C. CALKINS, Berkeley, Cal.

The paper is based on a study of specimens gathered during the last three summers, by the University paleontological expeditions conducted by Dr. J. C. Merriam. It may be considered as a supplement to Dr. Merriam's 'Contribution to the

Geology of the John Day Basin.' The igneous rocks of pre-Eocene age comprise quartz-mica diorite, serpentines and pyroxenite. The Tertiary series, including the fossil-beds, is almost entirely composed of volcanic materials. The Clarno Eocene began with the eruption of andesitic lavas and tuffs, followed by quartz-basalt and rhyolite. The John Day Miocene beds are mainly tuffs of trachytic and andesitic character. Upon them lie the great basalt series, which is in turn overlain by the Mascall beds, similar in general composition to the John Day. The Pliocene Rattlesnake formation comprises rhyolitic lava and tuffs. The most recent evidence of volcanic activity consists in ash-beds interstratified with the terrace gravels.

Colemanite: ARTHUR S. EAKLE, Berkeley, Cal.

The paper contains the results of a crystallographic study of a large number of colemanite crystals from the Calico district, San Bernardino, Cal. The crystals are exceptionally rich in forms and in the number of well-developed faces. Although only showing terminations on one end of the vertical axis owing to their attachment to the matrix, seldom less than twenty faces are present, and some of the combinations if completed would show upwards of one hundred faces. About fifty forms occur, of which one third are new. Four quite distinct habits are noticeable, governed by the absence or predominance of certain of the terminal forms. The measurements were made with the two-circle goniometer designed by Goldschmidt, and since this important method is comparatively new to the mineralogists of this country, a detailed description of the work is given, in order to make clear the method of calculating and projecting the forms. The figures accompanying the paper are a gnomonic projection of the forms, an orthographic projection on the base and several clinographic projections illustrating the varied habits and combinations observed.

Eocene and Earlier Beds of the Huerfano Basin, Colorado, and their Relation to the Cretaceous: R. C. HILLS, Denver, Colo.

The paper discusses the stratigraphical and structural features of the Huerfano Eocene, and associated Upper Cretaceous beds, for the purpose of correcting certain errors that appeared in earlier papers on the subject. The uppermost beds previously assigned to the Eocene have been shown to contain a Wind River and Bridger fauna, but there is a much greater thickness of conformable beds of similar character, the age of which has not been definitely established, which it is thought should be provisionally correlated with the Lower Eocene of the Uinta and San Juan basins. The Lower or Poison Canyon formation is found to be unconformable with the true Eocene and with the underlying Cretaceous, and to present a strong contrast with the latter lithologically. It is suggested that the Poison Canyon beds are nearly related to, if not identical with, the post-Laramie formation of the Denver Basin.

ANDREW C. LAWSON,
Secretary.

A NEW BAROMETRY FOR THE UNITED STATES, CANADA AND THE WEST INDIES.

A NEW system of reducing the barometric observations of pressure at the stations of the Government Services of the United States and Canada was put in operation on January 1, 1902. The Weather Bureau has received all the data necessary for carrying on the Canadian computations simultaneously with its own, through the courteous cooperation of Professor R. F. Stupart, Director of the Canadian Meteorological Office. The reduction of pres-

sures observed on the Rocky Mountain plateau to sea level is a problem of great scientific difficulty for two reasons: (1) Because it is not evident what the exact effect of the plateau is as modifying the ordinary Laplacean free air reduction, even when the mean temperature of the air column θ is assumed; and (2) because the vertical temperature gradient between the observed surface temperature t and the sea-level temperature t_0 is difficult to determine, or in other words because the connection between $\frac{1}{2}(t+t_0)$ and the true θ is hard to find. The solution of this problem has been forced upon the Washington Office ever since the opening of the service in 1870, inasmuch as the results of such reductions are used to form the daily weather maps, and the errors of reduction result in inaccurate systems of isobars, and consequently incorrect deductions regarding the existing weather conditions, especially west of the Mississippi Valley. The perplexity of the problem may be inferred from the fact that the present system constitutes the sixth effort to solve it. The indications are that the new isobars conform very closely to the true weather, and that the practical working of the system will prove to be satisfactory to the Bureau.

A brief summary of the earlier methods of reduction is as follows:

1. For the years 1870–81 all the low stations were reduced by an elementary application of tables given in Loomis' 'Meteorology' (the same as Guyot's table D, XVI., edition of 1859), using the temperatures observed at the moment of observation. 1872–1880. The higher stations were not reduced except by the application of a constant appropriate to the mean annual temperature and pressure; the lower stations continued with the elementary method, but this included an erroneous use of the observed pressure.

2. 1881–85. The Abbe-Upton system of monthly constants for each station, based on the mean monthly temperatures and pressures.

3. 1886–1887. Ferrel's system was in operation but found to be in a form which was too complicated for practical station work. However, some correct principles were introduced by him, namely, the mean temperature of twenty-four hours as the argument instead of the temperature at the time of observation; a separate correction for the plateau effect; the variation of the reduction with the local pressure; and a correction of the surface temperature t to the mean θ by an approximate vertical gradient.

4. 1888–1890. A mixed system, partly Ferrel's and partly Hazen's. 1891–1901. Hazen's empirical system alone, in which numerous changes were made in the wrong direction. The plateau correction was omitted, the pressure argument was abandoned, and the surface temperature not corrected to θ became the only argument. In constructing the empirical tables it was assumed that Mt. Washington is a correct type for the plateau effect, which is not true; the pressure on the sea level was taken as exactly 30.00 inches in working out the reductions, which does not conform to the facts; the check upon the reduction was limited to the criterion that the isobars could be smoothly drawn, and reductions for many stations received arbitrary modifications for that purpose. The result of this system was to give too high sea-level pressures at low temperatures, especially in cold waves, and too low pressures in warm weather.

5. In 1896 Professor Morrill computed tables which have been used somewhat in the office, but never published, in which the mean temperature θ and the pressure arguments were restored, and the treatment of the humidity put on an improved

basis, though the plateau effect was omitted and the correction between t and θ only roughly determined.

The following statement will indicate the most important changes which have been recently adopted. The principles introduced by Ferrel have been more closely followed than any of the others, but decided improvements have become possible by reason of the gradual accumulation of accurate observations on the plateau. It was first necessary to construct exact normals of station pressure. There have been numerous changes in the location of the offices during the past thirty years, involving variations in the elevation; there has been a gradual improvement in the general national surveys for elevation by which the local bases can be referred to the sea level; the instrumental errors were neglected during certain years when less than $\pm$ 0.007 inch; the observations have been made at different sets of selected hours; and the gravitation correction was not regularly applied. To reduce the entire set of observations from 1873 to 1900, inclusive, to a homogeneous system, they have been corrected to the elevation adopted for January 1, 1900, or the one occupied nearest that date, also to the mean of twenty-four hourly observations, and the corrections for instrumental errors and gravity have been added systematically. The monthly and annual means give the normals, and from these the variations in the year and from year to year are computed, the latter becoming the basis for the further discussion of climatic and seasonal problems.

The process of determining the sea-level temperature beneath the plateau was conducted as follows: The normal mean monthly temperatures of all stations between the Pacific coast and the Mississippi river were collected by groups according to their elevations, and reduced to selected planes through short distances. Thus all temperatures observed between 0 and 1,000 feet were corrected to the 500-foot plane, between 1,000 and 2,000 to the 1,500-foot plane and so on up to 7,000 feet. Temperature gradients in latitude and longitude were worked out by discussing these data, and then all the data on the selected planes were further corrected to values on the centers of reduction, that is the points where the five-degree meridians and the five-degree parallels intersect. The several stations were carried in various directions to different centers, so that purely local conditions might neutralize themselves. Over these centers we have thus formed from the observations different temperatures in a vertical direction, and they were then plotted as points on diagrams through the average of which vertical temperature curves were drawn, and prolonged to sea level without much error. These sea-level temperatures were now transferred to charts of the United States and Canada, and in connection with all the stations available from the Atlantic to the Pacific coasts, sea-level isotherms were readily drawn, by which all the minor discrepancies occurring in the plateau district were removed. By interpolation we then found the true terminals of the vertical temperatures at sea level on the centers of reduction. This entire work was performed two or three times in succession by a series of approximations, and the interlocking of the vertical and horizontal lines on the sea-level plane were made to conform to the observed conditions. Thence the sea-level temperatures for the respective stations were found by interpolation from the isotherms to tenths of a degree, so that we have thus accurately obtained t_0 as well as t.

The plateau effect was determined on the theory that the wide swing of the temperatures in the annual period, amounting

to 0.400 inch, should be reduced to that which is observed at the low-level stations, about 0.150, by a correction of the form $C.\Delta\theta.H.$, where C=0.00100, $\Delta\theta$ is the departure of the temperature from the annual mean, and H is the elevation in units of a thousand feet. This is readily computed for each station, and it is to be added to the free air correction computed by the Laplacean formula with modern constants.

The monthly station pressures B were now reduced to sea level, giving B_0, and isobars were drawn as well as possible through the resulting values. Many of the old stations had their elevations determined only by barometers and were quite erroneous; in many cases the temperature argument used $\frac{1}{2}(t+t_0)$ was not exact enough to give very accurate results; not a few stations had only a short series of years to use in constructing their normals; from these causes considerable irregularities were found on the first system of sea-level maps. The pressures for each station were now interpolated from the map, B_m, and the differences, B_0-B_m, computed. For certain stations these differences were about constant, indicating an error in the adopted elevation, or in the mean temperature from which the plateau effect was reckoned; in other cases the differences had a variation in an annual period, showing that the true value of θ differs from $\frac{1}{2}(t+t_0)$. By readjusting our data to allow for all these considerations, the sea-level pressures were computed a second time. The differences, B_0-B_m, were now quite small for stations of long record, usually less than 0.010 inch. Assuming that the normal values of the short record stations should be reduced to the long record series, that is, 20 to 27 years, these last residuals were added to the original station pressures B to give the station homogeneous normals B_n. There still remain a few stations, some of them at low level, so that any adopted method of reduction cannot be a possible source of error, wherein a nearly constant residual reduction is yet required to reduce them to the homogeneous system, marked ΔA. This is probably due to some local peculiarity of the wind circulation, or the exposure of the barometer, and it may properly be considered as a topic for further investigation.

We next proceeded to make reductions for all the stations now in operation to the 3,500-foot plane and the 10,000-foot plane, both of which are useful in the studies of cyclones and anticyclones, but instead of directly from B to B_1 and B_2, by a roundabout circuit. The sea-level values $B_m . t_0 . e_0 .$ pressure, temperature, vapor tension, were interpolated on the centers of reduction from the sea-level charts. The temperatures $t_1 . t_2$ and the vapor tensions $e_1 . e_2$, on the two upper planes, respectively, were computed by gradients derived from the cloud computations of 1896–97, and balloon and kite ascensions. With this data charts of $t_1 . t_2 . e_1 . e_2 .$ were formed, the pressures $B_1 . B_2 .$ on these planes were computed by means of our new logarithmic general tables, and the corresponding pressure charts drawn. Thence the station data $B_1 . t_1 . e_1 .$ for the 3,500-foot plane and $B_2 . t_2 . e_2 .$ for the 10,000-foot plane were interpolated for each month and for the annual mean. As a check, station data $B_n . t . e.$ were reduced so as to give corresponding to B_n the values of B_1 and B_2. We have thus derived $B_1 . B_2 .$ by two separate methods, and they generally agree to about 0.01 inch on the average. This check includes the construction of the general tables and the special station tables, also the drawing of the different sets of charts. We have therefore obtained the same results by means of two paths of reduction, the first to sea level from the station, and thence through the

centers of reduction to the two higher planes, and thence by interpolation to points over the station; the second, from the station pressure to the pressures on the two other planes directly. This agreement, therefore, unites the entire data in a homogeneous system, and it becomes the basis for future substantial scientific discussions in many meteorological problems. We can now deal quite confidently with hundredths of an inch of pressure.

A full report on this subject will appear in the Annual Report, Chief of Weather Bureau, Vol. II., 1900–1901, and will contain the following sets of charts for each month and for the year, $B_m . t_0 . e_0 .$ and the relative humidity on the sea level plane, $B_1 . t_1 . e_1$ on the 3,500-foot plane, $B_2 . t_2 . e_2$ on the 10,000-foot plane, 130 in all; also charts of gradients in latitude, in longitude and in altitude, as well as charts for reducing selected hours of observation to the mean of twenty-four hourly observations. With these data a newly opened station can by a little computation be put on a better basis regarding its normals than would be given by at least ten years of regular observations. A summary table contains the above list of normals for 265 stations besides the original data for the station $B_n . t . e.$, and will be a valuable source of reference for numerous questions in meteorology.

The reduction tables for pressure consist of three different sets: (1) The general logarithmic tables computed for every 100 feet up to 10,000 and for every 10 degrees from $-40°$ to $+100°$; (2) the station tables for publication, containing the following corrections for each of our three planes of reference, sea-level, 3,500-foot and 10,000-foot, namely, the Laplacean free dry air correction, the humidity correction, the correction for the plateau effect and the occasional residual correction, also the two arguments t surface temperature and θ the mean column temperature. Diagrams have been constructed to show the relations between t and θ, and they form a most instructive analysis of the plateau temperature problem, showing that each district has local characteristics of its own; (3) the station tables are compiled from the forms (2), and they are expanded for the arguments surface t and surface B, so that there shall be no interpolation along the temperature argument in order to obtain the nearest hundredth of an inch, 0.010. The body of the table gives the reduced pressure on its plane, and not the correction to the actual pressure, which must be added to it to produce the reduced pressure, as is customary in such tables. There remains only a very simple interpolation for the intervals of a tenth of an inch of pressure to the required hundredth of an inch. It is thus an easy matter to enter the three tables in succession with the same arguments, surface $(B . t)$, and find $B_0 . B_1 . B_2$. These data will enable us to construct three sets of isobars at each hour of observation, showing three plane sections through the atmosphere, and these will probably prove to be of value in the forecasts of the weather conditions. The sea-level reductions went into operation on January 1, 1902, as stated, but some more work is required to furnish the stations the necessary tables of group (3), the two preceding groups being completed.

FRANK H. BIGELOW.
WEATHER BUREAU.

SCIENTIFIC BOOKS.

Memorial Lectures delivered before the Chemical Society of London, 1893–1900. London, Gurney and Jackson, Paternoster Row. 1901. 8vo.

This volume contains the lectures commemorating deceased honorary and foreign members of the Chemical Society of London, delivered during the eight years designated in

the title, and if we take into consideration the historic eminence of the subjects of the lectures, as well as the fitness of the lecturers for their biographical tasks and their success in preparing them, it is safe to say that no more important or fascinating contribution to the history of chemistry has been issued within the decade. In each case care was taken to select as the lecturer one who had been personally intimate with the deceased chemist, or who was especially well qualified to write of his researches with the sympathy born of studies analogous to his; the result forms an illustration of the international character of science, for the native of Belgium is portrayed as to his life and labors by an American, the native of Switzerland by a Swede, the Germans by Englishmen, a Frenchman by another American, and only one lecture, on a Swede, is by a compatriot.

The methods followed by the lecturers in dealing with the individuals assigned them vary considerably, but the majority depict the personality of the chemist, his domestic life, his official duties, his positions of honor, and after these his labors and discoveries in the field of chemistry; in several instances the biographer introduces valuable disquisitions bearing on the theories which the person portrayed founded or helped to establish. Professor J. W. Mallet, of the University of Virginia, writing of Jean Servais Stas, precedes his account of the life-work of the Belgian in the determination of atomic weights, with a careful summary of the fundamental ideas that gradually led up to the question, 'What is the mass (or weight) of an atom of a particular element?'; and he presents a clear statement of investigations as to the atomic weight of the elements from the time of Berzelius to that of Stas. At the beginning of his painstaking researches Stas had an almost absolute confidence in the accuracy of Prout's hypothesis, but at their conclusion he said, 'The theory of Prout must be considered as a pure illusion.' Mallet himself, however, seems inclined to believe that there may be still something in it.

In passing, let me say that the biographer of Stas falls into the error of assigning to Wenzel a share in the discovery of the law of neutrality, an error originating with Berzelius, and often repeated, but corrected by J. S. C. Schweigger, Angus Smith, Ladenburg and by others.

In his lecture on Marignac, the Upsala professor, Cleve, introduces a skilful survey of the complicated history of the rare earths, including a table giving the characters of the elements of the yttrium-cerium groups that was highly esteemed at the date of its publication (1895).

Dr. W. H. Perkin, in his sketch of the labors of Hofmann, introduces an authoritative account of the origin of the coal-tar color industry, and both Drs. Japp and Thorpe in their lectures on Kekulé and on Victor Meyer, respectively, insert most praiseworthy contributions to the history of those branches of organic chemistry in which each was laboring so successfully.

These disquisitions do not partake of padding, but are among the most valuable features of this very valuable volume.

One of the most difficult men to treat, on account of his gigantic intellectual position, Helmholtz, is presented in a masterful way, notable for its vigor and brevity, by Dr. Geo. F. Fitzgerald.

Dr. Percy Frankland's biography of Pasteur is very readable and appreciative; he points out that the French chemist long ago 'completely foreshadowed and grasped that important branch of our science which we now call stereo-chemistry' as shown by the philosophical reflections made by Pasteur after his discoveries in connection with racemic acid. Some bold experiments conducted by Pasteur were designed to accomplish 'the task of turning the Creator's world upside down'; one of these was carried on at Lille in 1854. He had a clock arranged with heliostat and reflector, to reverse the natural movement of the solar rays striking a plant from its origin to its death, so as to ascertain whether in such an artificial world, in which the sun rose in the west and set in the east, the optically active bodies could be obtained in enantiomorphic forms. Dr. Frankland reviews Pasteur's studies on fermentation, his researches on

spontaneous generation, on the vinegar process, on the diseases of wine, of silkworms, and the beneficent results of his success in combating disease in man himself. Of the 20,000 persons who have taken antirabic treatment, the mortality has been less than five per thousand.

The four lectures on August Wilhelm von Hofmann occupy the most space given to any individual in the volume; Lord Playfair writes of his personal reminiscences of Hofmann and of the conditions which led to the establishment of the Royal College of Chemistry; Sir F. A. Abel narrates the history of the same College and of Hofmann's professional work therein; Dr. W. H. Perkin chronicles the contributions of Hofmann and his distinguished pupils to coal-tar color manufactures; and Professor Henry E. Armstrong contributes a very full and careful analysis of the scientific work of this great master in research.

Professor O. Petterson, of Stockholm, writes of Nilson; Sir Henry E. Roscoe in a delightful sketch of Bunsen, his intimate friend and teacher, mentions many amusing episodes of the absent-minded, genial, big-framed man who has been loved by all who came into contact with him; Dr. P. P. Bedson portrays Lothar Meyer; Professor J. M. Crafts, of Boston, writes of his warm friend, Friedel; and Dr. Thorpe, of London, writes of the brilliant Victor Meyer as well as of Hermann Kopp. With each of the twelve lectures there is an excellent portrait of the person sketched, and most of the lectures contain valuable bibliographies. A copy of this memorable volume (of which the edition is limited to 500) should be found in every good library.

HENRY CARRINGTON BOLTON.

Allgemeine Physiologie. Ein Grundriss der Lehre vom Leben. By MAX VERWORN. Third edition, revised. Jena, G. Fischer. 1900. Pp. 631; illustrations 295.

The facts that Professor Verworn's book has reached its third German edition, and that it has been translated into English, French, Russian and Italian, are evidence of its worth. That it has exerted an influence on the development of physiology during the six years of its existence is indicated by the frequency of references to it in physiological literature. The book improves with each successive edition. In its present revision it is unchanged in its fundamentals, but from the first to the last page it gives evidence of having been thoughtfully worked over. Apart from the alterations obligated by the newer researches, portions of the previous editions have been omitted, portions have been rewritten, and the language has constantly been made more precise. The quantitative result is an addition of twenty-five pages and ten figures, while qualitatively there is a betterment throughout. A few of the special features of the new edition may be here mentioned.

The use of the word *Eiweisskörper* has largely given place to that of *Eiweissverbindungen,* and stress is laid on the fact that the life process consists in the metabolism of the compounds of proteids rather than of proteids alone. The section on ferments is largely rewritten. As Emil Fischer has shown, it is now recognized that each ferment acts on one specific chemical body only, and not even on the isomers of that body. In many cases of ferment action by organisms, but not necessarily in all, the efficient substance is not the organism itself, but something secreted by the organism. Buchner proved this for alcoholic fermentation by the yeast-cell, and gave the name *zymase* to the enzyme. Another fact of interest is that no synthetic ferments have yet been discovered. Attention is called to the well-known results of Loeb and others in artificial parthenogenesis. Peter's observations that in ciliated cells the basal bodies are the place of origin of the impulse to movement are quoted. Peter's idea is supported by the work of Gurwitsch on the development of cilia.

The paragraphs on the origin of the current in a voltaic cell are rewritten and Sohncke's theory is replaced by that of Nernst. According to Nernst, metals have a great tendency to give off their molecules as cations in solutions of certain salts, the amount of loss depending on the relation of the osmotic pressure of the solution to the solution pressure

of the metal; the less the former and the greater the latter, the more cations are given off, and *vice versa*. The result of the loss is a charging of the metal with negative and of the solution with positive electricity. A second metal introduced into the solution, with a different relation of osmotic pressure and solution pressure, becomes charged positively, and the result is a difference of potential between the two metals.

In discussing the action of the galvanic current on protoplasm, the question is raised as to how the well-known effects are brought about. A possible factor is the electrolysis of the medium surrounding the living substance, in which case galvanic stimuli should be regarded as chemical stimuli. Verworn regards this possibility as doubtful, and if it occurs at all, it must be altogether subordinate. Much more important, doubtless, is the direct electrolysis of the living substance itself. A possible factor in the galvanic action is the movement of the liquids in the porous cell substance. This is suggested by the work of Carlgren, who, by the action of strong galvanic currents on dead cells, was able to obtain phenomena closely analogous to those occurring in living substance. The relative shares taken by these various factors in galvanic action must be decided by future investigation.

Molisch's work on the death of plants by freezing is noted, the general conclusion being that in such cases death is due to the abstraction of water from the protoplasm and the resulting profound alteration in the chemical structure of the compounds of the protoplasm. Regarding the action of chemical stimuli, the author takes the conservative position that in many cases, but not in all, osmotic action is associated with purely chemical action. The two factors have been only rarely distinguished sufficiently, and in most cases it remains to be decided to what extent the stimulating power of the chemical substance is due to its chemical, and to what extent to its osmotic properties.

The observations of Weil and Frank, which tend to disprove the hypothesis of the contractility of the dendrites of nerve cells, are quoted approvingly. So also is the work of Myer and of Overton, who found that the solubility of narcotics in fats and oils is a great factor in their narcotizing power. Narcosis is accomplished through the agency of the undivided molecule of the narcotic, not through its decomposition products. Narcosis appears to be a contact effect.

The author devotes a page to the discussion of the effect of the Roentgen rays on organisms, but the facts so far discovered are too few to allow conclusions of value to be drawn.

In discussing the origin of life the theory of F. J. Allen is added to those heretofore given. This author believes the beginnings of life to date, not as Pflüger assumes, from the time of the earth's incandescence, but from the period when water first appeared on the earth's surface. The powerful shocks of lightning which must have occurred continually in the damp, warm atmosphere then existing, led to the production of ammonia and the oxides of nitrogen, as happens to-day. These substances were carried down in solution by the rains, and on the surface of the earth met solutions of carbonic acid and the chlorides, sulphates and phosphates of the alkalies and metals. Thus the opportunity was given for the most varied nitrogenous combinations, and the first living substance then came into being.

The chapter on the mechanism of life is not greatly altered. The 'biogen hypothesis,' as the author now terms it, is considered somewhat more fully than before, in the light of the work of Detmer, Loew and F. J. Allen, but it is not essentially changed. Attention is called to Jennings's careful work on the mechanism of tactic movements, and to Rhumbler's interesting physical analyses of cell phenomena.

In the preface Professor Verworn speaks of the present great activity of investigators in all fields of general physiology, and laments the fact that within the narrow confines of one book so many of the important contributions must be mentioned without discussion or be omitted altogether. Notwithstanding this fact, his book still remains by far the best

existing treatise on the varied subjects included under its comprehensive title.

FREDERIC S. LEE.

COLUMBIA UNIVERSITY.

SCIENTIFIC JOURNALS AND ARTICLES.

THE February number (Vol. VIII., No. 5) of the *Bulletin of the American Mathematical Society* contains a report of the eighth annual meeting of the Society, by the secretary; a report of the January meeting of the Chicago Section, by T. F. Holgate; a review of Wilson's Vector Analysis, by Alexander Ziwet; a review of books by M. Simon and J. M. Hill on Euclid, by J. S. Coolidge; 'Notes' and 'New Publications.' The March number of the *Bulletin* contains the following articles: 'The Application of the Fundamental Laws of Algebra to the Multiplication of Infinite Series,' by Florian Cajori; 'Concerning the Class of a Group of Order p^m that Contains an Operator of Order p^{m-2} or p^{m-3}, p being a Prime,' by W. B. Fite; 'Proof that the Group of an Irreducible Linear Differential Equation is Transitive,' by Saul Epsteen; 'Lines of Length Zero on Surfaces,' by L. P. Eisenhart; 'Some Properties of Potential Surfaces,' by Edward Kasner; a review of Gibson's Calculus, by W. F. Osgood; 'Shorter Notices' of Cohen's Theory of Numbers and Beman's translation of Dedekind's Essay on the Theory of Numbers, by L. E. Dickson, and of the Annuaire des Bureau des Longitudes, by E. W. Brown; 'Notes' and 'New Publications.'

The American Naturalist for February opens with an article by W. M. Wheeler on 'A New Agricultural Ant from Texas, with remarks on the known North American Species,' the new ant being *Pogonomyrmex imberbiculus*, while the notes include a key for the identification of the species. Under the caption '*Phyllospadix* as a Beach-builder,' R. E. Gibbs presents some new information regarding its life-history and shows how its spreading tufts hold the sand and produce sand-bars. G. H. Shull gives 'A Quantitative Study of Variation in the Bracts, Rays, and Disk Florets of *Aster Shorti* Hook., *A. Novæ-angliæ* L., *A. puniceus* L. and *A. prenanthoides* Muhl., from Yellow Springs, Ohio.' The number contains the 'Quarterly Record of Gifts, Appointments, Retirements and Deaths,' and it is noted that hereafter these will appear in the numbers for February, May, August and November. The gifts for the past year to schools, colleges, libraries and museums amounted to $43,233,635, and this does not include Mrs. Stanford's transfer of securities to Stanford University nor any appropriations made by national, state or local governments.

The Popular Science Monthly for March contains a long and well-illustrated article by J. C. Branner on 'The Palm Trees of Brazil,' describing the appearance and uses of many species. Alexander F. Chamberlain treats of 'Work and Rest: Genius and Stupidity,' drawing the inference that brief periods of intense work and long periods of rest produce better results than long periods of steady application. 'Science in 1901' is a résumé of progress along various lines from wireless telegraphy to the better understanding of yellow fever, reprinted from the London *Times*. Ellis P. Oberholtzer describes 'Franklin's Philosophical Society,' the oldest scientific society in the country, and W. H. Dall contributes an appreciative biographical sketch, with portrait, of the late Alpheus Hyatt. W. G. Sumner tells of the comparatively recent extraordinary outbreak of 'Suicidal Fanaticism in Russia,' and Lindley M. Keasbey discusses 'The Differentiation of the Human Species,' believing that mankind was homogeneous prior to the glacial period. E. B. Titchener, after considering the problem 'Were the Earliest Organic Movements Conscious or Unconscious,' decides in favor of the necessity of mind at the first appearance of life. Finally we have the full text of the 'Trust Deed by Andrew Carnegie creating a Trust for the benefit of the Carnegie Institution.'

SOCIETIES AND ACADEMIES.

AMERICAN PHYSICAL SOCIETY.

THE regular bimonthly meeting of the Physical Society was held at Columbia

University on Saturday, February 22. The severe storm in the region near New York at that time delayed the arrival of many of those present, and doubtless prevented others from coming. But the attendance was satisfactory in spite of the storm, and the meeting an enjoyable one.

A paper on the 'Velocity of Light,' by President Michelson, took the place of the president's annual address, which could not be delivered at the holiday meeting of the Society on account of Professor Michelson's unavoidable absence. The paper contained a brief discussion of the various determinations of the velocity of light, together with the determinations of the ratio of the electrostatic and electromagnetic units, and of the velocity of electric waves. The conclusion was reached that the great theoretical importance of demonstrating, or disproving, the absolute equality of these three quantities made a redetermination of the velocity of light desirable. Certain criticisms, from the theoretical standpoint, of the revolving mirror method, which up to the present time has given the most consistent results for V, were also mentioned. A method was proposed which combined the advantages of both the method of Cornu, in which a toothed wheel was used, and the method of the revolving mirror, as used by Michelson and by Newcomb. While free from the objections that have been suggested in connection with the latter method, the method proposed promises a higher accuracy than has ever heretofore been reached.

In a paper on 'Magneto-striction in Bismuth,' by A. P. Wills, experiments were described which were intended to detect any change in length in bismuth produced by longitudinal magnetization. Similar tests by Bidwell had shown an appreciable elongation for a magnetic field of less than 2,000 c. g. s. units. The experiments of Professor Wills were made with a stronger field and with an arrangement of levers of sufficient sensitiveness to show a much smaller elongation than that reported by Bidwell; but no effect could be observed.

In a paper entitled, 'The Transmission of Sound Through Solid Walls,' Mr. F. L. Tufts gave the results of determinations of the transmitting power for sound of various non-porous walls. The results were in many respects different from what would probably be anticipated from a hurried consideration of the case. For example, a wall of sheet lead, in spite of its great density and its lack of elasticity, was found to transmit much more sound than a glass wall of equal thickness. Two walls separated by an air space were no more effective in cutting off sound than the same two walls in contact. The results indicate that the sound is transmitted in such cases by the forced vibration of the wall as a whole, not by the elastic waves carried through the wall. Other things being equal, that medium which yields most to pressure steadily applied will transmit best.

Professor A. G. Webster, in a paper on the 'Spherical Pendulum,' showed some very pretty traces illustrating the vibrations of a pendulum whose motion is not restricted to one plane and whose amplitude is large. The traces were made by photographing the path of a small incandescent lamp attached to the pendulum bob. The theory of such a pendulum was briefly discussed, and it was shown that the traces actually observed were in close agreement with those predicted by theory.

Certain distorted coronas, produced by a medium containing drops of moisture of different sizes, were described by Carl Barus in a paper entitled 'The Flower-like Distortion of Coronas Due to Graded Cloudy Condensation.' The author developed the theory of such coronas and showed that it was in agreement with observation.

A second paper by Professor Barus dealt with 'Persistent Nuclei Produced by Shaking Solutions of Solids, Liquids or Gases.' The author stated that whereas the nuclei produced by pure water were very fleeting, nuclei produced by solutions persisted until removed by gravity. It follows that small droplets of solutions do not evaporate below a certain dimension, very large compared with molecular dimensions.

The results of measurements of the current between a cold metal and an incandescent carbon kathode were presented in a paper by

Ernest Merritt and O. M. Stewart. Curves were shown giving the observed relation between current and potential difference for different degrees of incandescence and for different air pressures. At low pressures (0.05 mm. or less) these curves were similar to the 'saturation' curves observed in the case of conduction due to Röntgen rays, etc. With increasing potential difference the current at first increased, reached a maximum at about six volts, and then remained practically unaltered for higher potentials, even up to 120 volts. At pressures in the neighborhood of one millimeter the curves were of the same character at low potentials; but instead of remaining constant throughout the whole range from six volts to 120 volts, the current remained unaltered until a potential difference of about thirty volts was reached, and then increased rapidly for higher voltages. The authors suggest that the result may be explained by the ionization of the residual gases by the negative ions from the incandescent carbon.

The Society voted to request the Council to arrange for a summer meeting of the Society in connection with Section B of the American Association for the Advancement of Science.

ERNEST MERRITT.

AMERICAN MATHEMATICAL SOCIETY.

A REGULAR meeting of the American Mathematical Society was held at Columbia University on Saturday, February 22. Vice-President Maxime Bôcher occupied the chair. Thirty members were in attendance at the two sessions. The Council announced the election of the following persons to membership in the Society: Professor Edward Brand, Howard College, Ala.; Mr. D. R. Curtiss, Harvard University; Miss Alice B. Gould, Boston, Mass.; Dr. Carl Gundersen, Columbia University; Mr. A. F. van der Heyden, Middlesbrough, Eng.; Rev. Jean de Seguier, S. J., Paris, France; Mr. J. W. Young, Cornell University. Fourteen applications for membership were received.

The term of Professor T. S. Fiske as member of the editorial board of the *Transactions* having expired, he was reelected for a term of three years. Dr. Edward Kasner was reelected assistant secretary. It was decided to hold the next summer meeting of the Society at Evanston, Ill., about the end of August.

The organization of a Pacific Section of the Society is now under consideration. The activity and number of members on the Pacific slope would appear to justify the Council in granting the desired authorization. The Chicago Section, founded in 1898, has proved a gratifying precedent.

The Annual Register of the Society has recently appeared, containing the list of officers and members, annual reports, constitution and by-laws, and a complete list of all periodicals now in the Society's library. The total membership of the Society is now 379, of whom 18 are life members. The treasurer's report shows a credit balance of over $2,000, in the face of a considerable expenditure for the *Transactions* and the *Bulletin*.

The following papers were read at the February meeting:

Dr. E. V. HUNTINGTON: 'A complete set of postulates for the theory of absolute continuous magnitude,' 'Complete sets of postulates for the theories of positive integral and positive rational numbers,' and 'A simplified definition of a group.'

Dr. M. B. PORTER: 'On the arithmetic nature of the zeros of Bessel functions.'

Dr. W. B. FITE: 'On a property of groups of order p^m.'

Professor L. E. DICKSON: 'The groups of Steiner in problems of contact.'

Dr. VIRGIL SNYDER: 'On the forms of quintic scrolls.'

Mr. PERCIVAL LOWELL: 'On the capture of comets by Jupiter.'

Mr. H. L. RIETZ: 'On primitive groups of odd order.'

Professor MAXIME BÔCHER: 'On systems of linear differential equations of the first order.'

Dr. E. J. WILCZYNSKI: 'Covariants of systems of linear differential equations.'

Professor JAMES MACLAY: 'On some associated surfaces of negative curvature.'

Professor E. W. BROWN: 'On the small divisors in the lunar theory.'

Mr. OTTO DUNKEL: 'Some applications of Green's theorem in one dimension.'

Mr. J. W. YOUNG: 'On a certain group of isomorphisms.'

Dr. A. S. Gale: 'On the rank, order and class of algebraic minimum curves.'

Mr. W. H. Roever: 'Brilliant points and loci of brilliant points.'

At the close of the regular program Professor A. G. Webster gave a résumé of a paper, also read before the American Physical Society, on 'The Motion of a Spherical Pendulum,' illustrating it with photographs and stereopticon views.

The next meeting of the Society will be held on Saturday, April 26. The Chicago Section will meet at the University of Chicago on Saturday, March 29.

F. N. Cole,
Secretary.

MEETING OF THE NEBRASKA ACADEMY OF SCIENCE.

The twelfth annual meeting of the Nebraska Academy of Science was held the 24th and 25th of January, 1902, at the University of Nebraska, Lincoln, Nebraska.

The President's address, given by Professor E. W. Davis, was upon the subject, 'The Numerical Basis of Induction'; the remainder of the program being composed of the following papers:

'A Method of Instruction in Crystallography,' by Professor E. H. Barbour, in which he described an original method of instruction by the use of paper models to illustrate the extension of the faces; and plaster of Paris models, to allow of cutting in various planes, in which may be imbedded strings to show the position of the axes. He also showed apparatus for casting the latter.

'Preliminary Notice of a Bacterium Associated with Apple Rot,' by Mr. P. J. O'Gara, a review of experiments tending to show that rotting of apples is due to bacilli hitherto undescribed.

'Some New Properties of Conics,' by Dr. Carl C. Engberg, in which he illustrated some new facts bearing upon the transformation of well-known curves into other curves in accordance with certain assumed conditions.

'Report of Progress of the Nebraska Geological Survey': Professor E. H. Barbour.

'The Quadrat Method in Phytogeography,' by Dr. F. E. Clements, in which the author described the way in which this method was applied and gave some curious results of an attempt to estimate plant population under certain conditions.

'A New Bat Parasite,' by J. C. Crawford, Jr., being a description of a new genus and species belonging to the family Hippoboscidæ which has hitherto only been reported in North America from New Mexico.

'The Fossil Bryozoa of Nebraska,' by Professor G. E. Condra, in which he stated that the total number of species known for the State was 51, of which a score were hitherto undescribed.

'On a New Form of Psychrometer,' by Mr. John Fossler, in which he described a form of psychrometer in which the thermometers were rotated about a vertical plane with such a small radius that the apparatus could be used in a very limited space without at the same time any loss in accuracy.

'New Bird Lice from Nebraska': M. A. Carriker, Jr.

'Notes on North American Bees': J. C. Crawford, Jr.

'Nebraska Water Mites': Dr. R. H. Wolcott.

The last three papers were entirely systematic, containing descriptions of new species, together with records of occurrence, and in the case of the last paper also a table for the separation of species and such biological data as would present a complete view of what is known of the hydrachnid fauna of the State.

'Some Observations on the Buried Rock Surface of Eastern Michigan': Dr. C. H. Gordon.

'On the Use of Closed Aquaria in Schoolrooms,' by Professor Haven Metcalf, in which the author also gave hints on what could be grown, where and how to gather it and the best methods of cultivating the same.

'Some Remarkable Fossil Shark's Teeth from Nebraska,' by Professor E. H. Barbour and Carrie Barbour, in which the authors called attention to some teeth of *Campodus* and other sharks much more perfectly preserved than any hitherto found.

'The Strength of Nebraska-grown Catalpa and Osage Orange,' by Professor G. R. CHATBURN, a paper of considerable practical importance for the suggestions made as to the properties of the woods named for various economic purposes.

'Progress of the State Botanical Survey': Dr. ROSCOE POUND.

'The Present Knowledge of the Distribution of *Daimonelix*,' by Professor E. H. BARBOUR, detailing the great extension in range of this curious fossil which has resulted from the work of the State and national geological surveys, together with researches carried on by private individuals in Nebraska and adjoining States.

'Some Recent Changes in the Nomenclature of Nebraska Plants,' by Professor C. E. BESSEY, these changes being rendered necessary by the modifications of nomenclature introduced in recent botanical text-books.

'Relative Humidity in Dwelling Houses,' by Professor G. A. LOVELAND, giving the results of experiments upon the humidity of houses heated by various means, and the results of experiments with various expedients to increase the degree of moisture.

'A New Form of Sunshine Recorder,' by Professor G. D. SWEZEY, describing an instrument capable of registering not only the total amount and hours of sunshine during the day, but also varying intensity.

'Suggestions for a Revision of *Alysidium*': Dr. ROSCOE POUND.

'Preliminary Table of the Described Species of *Andrena*': Professor L. BRUNER.

'Some Observations on the Leeches of Nebraska': Professor HENRY B. WARD.

The last three papers were largely systematic.

'Plant Formations of Colorado': Dr. F. E. CLEMENTS.

'Some Experiments on the Paving Bricks of Nebraska': Mr. C. A. FISHER.

'Discovery of the Laramie Cretaceous in Nebraska,' by Mr. C. A. FISHER, in which he called attention to observations which extended the formation over the Wyoming line into Nebraska.

'Notice of certain fine Selenite Crystals from Cedar County, Nebraska': Professor G. E. CONDRA.

Forty-five members of the Academy were in attendance and an unusual amount of interest manifested. The secretary reported on the publication of Vol. VII. of the Proceedings, being a volume of 170 pages and 15 plates, which had recently come from the press, and also upon the plans for the immediate publication, as Vol. VIII., of the proceedings of the present meeting.

Forty-four new members were elected and the following officers decided upon for the ensuing year:

President, Professor J. H. Powers, Doane College, Crete; ***Vice-President***, Professor H. B. Duncanson, State Normal, Peru; ***Secretary***, Dr. R. H. Wolcott, State University, Lincoln; ***Treasurer***, Professor G. A. Loveland, United States Weather Bureau, Lincoln; ***Directors***, Mr. William Cleburne, Omaha; Dr. C. H. Gordon, Lincoln; Professor A. A. Tyler, Bellevue College, Bellevue; Dr. A. S. Von Mansfelde, Ashland.

The Academy passed resolutions commendatory of the United States Hydrographic Survey, and also resolutions endorsing the proposal to establish tree-planting reserves in Cherry County, Thomas County and in Grant and Arthur Counties in the sand-hill region of the State.

After the transaction of other minor business the Society adjourned for one year.

ROBT. H. WOLCOTT,
Secretary.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

AT the 547th meeting, held February 15, 1902, Dr. A. L. Day continued his paper begun at the previous meeting. He reviewed briefly the history of high temperature measurement from the Wedgewood clay pyrometer (1782) down to the most modern mechanical, electrical and optical methods. The interesting development of gas thermometry was treated in some detail; the remarkable early measurements of Prinsep, Pouillet and Becquerel with the more perfect gases and metallic bulbs; the hardly less remarkable, but unfortunate, experiments of Sainte-Claire Deville and Troost with iodine vapor in porcelain bulbs, which led pyrometric measurement in

the wrong direction for so many years; the extensive and nearly simultaneous researches of Dr. Barus in the Geological Survey and Holborn and Wien in the German Reichsanstalt; and finally the successful return to first principles at the Reichsanstalt, with the help of the electric oven and the experience of the long line of distinguished predecessors, in which the speaker himself had a part.

The various methods for carrying pyrometric measurement beyond the range of the gas thermometer by making direct comparisons with it as far as it is available, and extrapolating the empirical relation thus obtained, were then taken up; Violle's calorimetric method, by which he obtained the results generally accepted for twenty-five years or more; the electrical resistance method (Siemens, Callendar and others), depending upon the variation in the resistance of a platinum wire with the temperature; the thermoelectric method (Barus, Holborn and Wien, and others), depending upon the electromotive force developed in a pair of wires (*pt* 90 *rh* 10—*pt* 10 usually) whose junctions are maintained at different temperatures; and several others. In closing, some recently published optical methods were reviewed (Berthelot, Lummer, Holborn and Kurlbaum) which promise to extend the upper limit of measurable temperatures almost indefinitely though with what accuracy, in view of the extent of the extrapolation necessary, it is hardly possible yet to say.

Dr. Day gave as the approximate limit of accuracy of the best methods now available $\pm 1°$ up to $1000°$, $\pm 10°$ to perhaps $1600°$, $\pm 100°$ to $3000°$ or more. He did not consider that the limit had been reached either in the accuracy or range of pyrometric measurement or even of gas thermometry and expressed regret that no more attention was being paid to so promising a field in this country.

Dr. L. A. Bauer presented a paper on 'Energy and Entropy: Their Rôle in Thermodynamics and Thermochemistry.' As suggested by the title, the respective rôles played by the two fundamental principles of thermodynamics, the principle of the conservation of energy and the principle of the increase of entropy, were set forth and elucidated by examples. It was shown that as much is known about the physical properties of entropy as of energy, and that in the phenomena of heat the entropy principle first comes into play, prescribing the direction or method in which stable equilibrium can take place. After the state of equilibrium has been reached then the principle of energy can be applied. It was shown that it would be a gain, now that the entropy function has been found, to discard the historical method of establishing the entropy principle and instead adopt a method similar to that followed by Hertz with regard to the fundamental equations of electromagnetism—*i. e.*, begin with an equation expressing a relation between the specific heats at constant pressure and at constant volume which admits of experimental proof and which prescribes that the entropy function has the same essential property as energy, viz., of being independent of the path or process used in going from one state to another.

A relationship between entropy and the term introduced by Helmholtz—*wärmegehalt*, changed by von Bezold to *potential temperature* and used by him extensively in his paper on the 'thermodynamics of the atmosphere,' was established and the name *entropic* temperature in place of *potential* temperature suggested.

Charles K. Wead,
Secretary.

DISCUSSION AND CORRESPONDENCE.

AGRICULTURE AND THE EXPERIMENT STATIONS.

The agricultural experiment stations of the United States, which the Federal Government has established in the several States, have now themselves passed the experimental stage and have to a remarkable degree won the respect and confidence of the farming and allied interests which it is their function to serve. There are at present fifty-nine experiment stations more or less completely maintained by Federal funds, two of which are colonial, and one of which is in Alaska. The organization and location of the continental stations affords an interesting example of the effect of the application of political conceptions to scientific investigation.

Agriculture is simply the business of growing plants and selling their products, either directly in the form of crops or indirectly in the form of the animal body into which they have been converted.

Affecting this are soil and climatic conditions, the market, the farmer's knowledge of the plants he grows and of the best methods for marketing their products.

None of these factors has anything to do with state boundaries. The fact that wheat is grown in a certain state is of no more, nor indeed of as much, significance as the fact that it is grown along a certain line of railway. A State boundary is a fiction of some political, but of absolutely no scientific importance whatever. A range of mountains or a river, on the other hand, is of tremendous significance so far as its effect on plant life is concerned. The northern and southern boundaries for a state like Kansas, two hundred miles wide, may be of some importance scientifically, as representing whatever differences in fauna or flora may be found resulting from the rather slight difference in the mean annual temperature of the two regions. But from the standpoint of scientific agriculture there is not a tithe of the significance in such a difference north or south from the center of this State as in the two hundred miles east or west of that point. Still more strikingly is the same fact exemplified in the states of Oregon and Washington.

The significant thing to know is not whether a given crop can be raised in the state of Oregon or in the state of Washington, but whether it can be raised in the region east of the Cascades, where there is a small annual precipitation and great evaporation, or west of the mountains where the reverse is true.

What does it convey to a scientific mind to say that such and such varieties of wheat are best for Ohio or Nebraska, when regional or climatic conditions within these states may furnish areas which demand wheat varieties of the most diverse character? Politically a state is a plane surface, holding a certain number of inhabitants subject to exactly the same civil laws.

Scientifically regarded, a state is an arbitrary block of territory chopped out at random, sometimes consisting of some vast physiographic domain of mountain, forest or prairie, sometimes comprising portions of all these within its imaginary boundaries.

One would naturally suppose that in the location of agricultural experiment stations, the points alone considered would be physiographic and meteorological ones. For scientific purposes, for example, one station in the western fourth of any one of those portions of the earth's surface called North Dakota, South Dakota, Nebraska or Kansas could more efficiently solve the problems of that whole vast region than can the present four stations, each of which is located outside of the high plains area, and in the eastern part of its geographic fiction, the state, which represents in each case in the eastern and western portions, such opposing facts of climate and topography.

One would naturally suppose that a geographical area of 62,000 square miles, of such very similar conditions as regards soil, climate and physiography as are found in the New England states, would scarcely need be provided with as many stations for experiment in agriculture as the region of 262,000 square miles which we call Texas, and which contains such diverse climates as are found in the humid tropical region of Brownsville, the desert tropical of El Paso, and the high, cool, semi-arid area of the Staked Plains. Yet we find six stations in the former and one in the latter geographic area.

The inconsistency involved in the absurdly unscientific location and distribution of our experiment stations is seen at a glance on a map of the United States having the stations prominently marked. Two stations dominating similar areas so far as agriculture is concerned, and of necessity dealing with precisely the same problems are found located ten miles from each other. But because they are in the separate 'states' of Idaho and Washington, it occurs to nobody to be an economic waste, as it certainly would if the neighboring boundary line were moved ten miles east or west, thereby throwing them into the same 'State.'

The location of stations within seventy miles of each other and in the midst of sim-

ilar areas impresses no one as useless, so long as it is known that one is in Wyoming and the other in Colorado.

This fundamental error involved in the establishing of one of the United States experiment stations in each state, regardless of the facts of climate, soil or physiographic aspect, which may make a unit of several states for the purposes of agricultural experiment or may subdivide one state into several wholly distinct areas so far as plant life is concerned, must necessarily be responsible for a lesser efficiency to the country in proportion to the number of stations established than would exist if locations had been settled upon by a committee of scientific experts, without any regard whatever to state boundaries.

In other words, the quasi-dual nature of the experiment stations, receiving as they do their support from the Federal Government while their allotment is to the states as such, to which are also left the direction and control of the experimental work, together with the appointment of their staffs, results in a regrettable lack of coordinated and economically directed work. It would seem that experiments in agriculture in the various agricultural areas of the country would be conducted to much better advantage, if all the operations of the Federal experiment stations were planned, directed and controlled directly by the Department of Agriculture at Washington. This, in fact, is the only way in which the faults of indirection and of duplication of work could well be avoided. Under the control of the Federal Government, the problems of each agricultural area could be assigned to such stations as were best fitted to deal with them, instead of their energies being distributed vaguely over a variety of subjects, more or less intermittently and at haphazard, as local influences or the curiosity of the individual investigators dictate.

One of the great difficulties with experiment station workers at present is the isolation in which they labor, and the limitations of their outlook upon agricultural problems in general, due to the intense localization of their work and thought. This cannot well be otherwise, as lack of funds precludes them from the travel necessary to gain a knowledge of the work of other experiment stations, and the conditions of other agricultural regions.

If the experiment station staffs were filled by civil service appointment from Washington, and a system of transfers from station to station and back to Washington were made possible, it would seem that the resultant increased breadth of view, and more comprehensive grasp of the problems of scientific agriculture would inure greatly to the benefit of the whole country. By such a system of transfers the right man to attack any given problem could be detailed, at any time, to any experiment station in the United States, while by a civil service system of appointments a constantly higher standard of efficiency than now prevails could be insured everywhere.

At the present time a tendency seems to exist, if one station makes a reputation for itself in any one line of experiment, for others in the neighborhood to be stimulated to emulate, and if possible to excel, its efforts, due to the influence of state pride or rivalry. A duplication of work here occurs which is often wasteful and useless.

Under a Federal system of control a given problem might oftentimes be divided and assigned in part to three or four stations working coordinately. The advantage of such an assignment in the case of many experiments is sufficiently obvious.

One of the difficulties in the way of the highest efficiency on the part of experiment station workers lies in the association of the experiment stations with the state educational institutions, and the combination of the duties of a teacher in one of these with those of an investigator in the experiment station. As a matter of fact, the work of the teacher and the investigator cannot be wholly divorced, but oftentimes by far the greater part of the time of the experiment station men is swallowed up in the details of college duties, to the serious detriment, of course, of the work of the station. The absolute separation of the federal station workers and the state agricultural college workers, so far as their duties are concerned, need not prevent the chemist

of the station from doing some teaching in soil chemistry for example, or the professor of botany of the college from taking advantage of the work and, so far as possible, sharing the interests of the botanist of the experiment station.

The main necessities then for the increased efficiency of our agricultural experiment stations would seem to be:

1. A centralized management, with the direction and distribution of all experimental work left to a single board of control, preferably to be connected with the United States Department of Agriculture.

2. A system of civil service appointments to positions in all Federal stations, and an elasticity in the organization of the different staffs, making possible the transfer of scientific workers from one station to another according to the judgment of the governing board.

3. The complete separation of the experimental research work of the station investigators and the pedagogical work of the college teachers of science in localities where the experiment station is located on the grounds of a state institution. This would necessitate an increased salary roll in both the college and station, but would increase the working efficiency of both in a far greater ratio.

H. F. ROBERTS.

KANSAS STATE AGRICULTURAL COLLEGE.

INJURIES TO THE EYE, CAUSED BY INTENSE LIGHT.

MR. FRANK ALLEN'S observations in these columns (January 17, 1902, p. 109) suggests an experience of my own which is worth recording in some detail.

Last April I ran the projection lantern one evening for a friend, the exercise lasting nearly two hours. The lantern is an arc lamp, hand feed, and the current was giving some trouble. The arc had to be kept rather short, and it was necessary to look in at the arc very often. To guard my eyes from the glare, I had three thicknesses of blue glass in front of the arc. Yet I noticed that my eyes were being injured. At the close of the lecture there was a distinct dimness in the center of my field of vision. This has often happened after looking at a bright light, and I thought nothing of it. Next morning, however, my neighbor at breakfast wore a bright yellow rose, and I noticed a distinct spot of pink on it, yet on examining it closely there was no pink, or at least only a trace of pink in the center of vision. At a distance of six feet the whole rose was pink.

On the street that morning, an orange peel on the walk at a distance of twelve feet was bright red; on a nearer view only a central spot was red. And every yellow house had a pink spot, and every orange surface a red one from that time on. Then I saw that in reading there was a gray area on the page in the center of vision.

It was plain that focusing so long on the arc through the blue glass had paralyzed or killed the cones in the *fovea centralis* and its immediate vicinity—that is, such cones as normally respond to the short waves at the blue end of the spectrum. So my eyes in that area of the retina responded only to the longer or red waves from the rose or the orange, and in ordinary vision I was deprived of just that much illumination.

This condition persisted in a very striking way all summer, but gradually disappeared in the autumn, and now, at the end of ten months, I can discover no trace of the dimness in the center of vision, nor can I see any trace of pink in a yellow surface. So whatever the disability was, it has been overcome. If the cones were destroyed, they have been replaced; and if only paralyzed, they have resumed their normal function.

J. PAUL GOODE.

THE UNIVERSITY OF PENNSYLVANIA.

A GEOGRAPHICAL SOCIETY OF NORTH AMERICA.

TO THE EDITOR OF SCIENCE: Referring to the very interesting letter from Professor W. M. Davis (SCIENCE, XV., No. 373, p. 313, February 21, 1902), there seems to be no reason why the aims of the professional geographer should exclude any non-professional who is anxious to keep in touch with the latest advances in geographical knowledge.

Their need is apparently mutual. The pro-

fessional should be glad of all the support, moral and financial, which he can secure throughout the community, while there are many students who wish to keep advised of all progress as it is made.

Let the 'professionals' constitute the 'members' of the Society and let the test for 'membership' be as rigid as may be found necessary, so that being a member shall constitute *prima facie* evidence to the world of established professional ability and experience.

Let there also be a class of 'associates,' who shall include any respectable person of legal age (duly elected) who desires to join and is willing to pay the established dues.

All members should be elected as associates and any associate should have at all times the privilege of applying to a 'board of examiners' for election to full membership.

This course of procedure has been found satisfactory in the American Institute of Electrical Engineers and in other engineering bodies. It preserves to the professional all the honor and exclusiveness which he can desire, yet serves to draw into a compact and powerful organization all who for any reason wish to keep in touch with the most recent advances.

Such an inclusive policy would seem to be the wise course for all of our scientific societies, each of which is supposed to exist for the purpose of educating the public at large and of arousing a widespread interest in its specialty as well as for the benefit of its professional members.

J. Stanford Brown.

New York City.

THE PHYSIOLOGICAL EFFECTS OF THE ELECTRICAL CHARGE OF IONS.

In No. 374 of Science Professor Lee gives a review of the Chicago meeting of the American Physiological Society in which he says that I 'maintained that vital phenomena, in general, are caused by the electrical charges of ions.' I wish to state that I have never held nor expressed such an opinion.

Jacques Loeb.

The University of Chicago,
March 3, 1902.

NOTES ON INORGANIC CHEMISTRY.

In proposing the toast, 'The Houses of Parliament,' at the annual dinner of the fellows and associates of the Institute of Chemistry held in London last December, Professor Ramsay referred to the recent jubilee of Professor Berthelot in Paris and the cooperation of the French government with the scientific societies in honoring the distinguished chemist. He then said that while the British government often has occasion to take the advice of scientific experts, it does not as a rule honor science generally in the persons of those who have most distinguished themselves, as is done in many other countries. He called attention to the work of the chemists of the United States Geological Survey, and regretted that this example is not followed by the Geological Survey of Great Britain. Touching upon the question of water supplies, he gave it as his opinion that, valuable as the bacteriological examination of water is, it must be looked upon as merely confirmatory of the examination of the chemist. In responding to this toast for the House of Commons, Mr. Hanbury remarked incidentally that science would be of incomparably more practical value if its 'hideous terminology' could be done away with.

The question of the existence of the ammonium radical, NH_4, has been very exhaustively studied by Moissan, whose results are published in the *Comptes Rendus* and in the *Archives Néerlandaises*. His methods included the electrolysis of ammonium chlorid and ammonium iodid in solution in liquid ammonia, the examination of ammonium amalgam at a temperature as low as $-90°$, where the amalgam is perfectly stable, and the action of liquid hydrogen sulfid on lithium-ammonium and calcium-ammonium at $-75°$. In none of the experiments was any evidence of free ammonium found, incidentally confirming the recent results of Ruff. Moissan believes, however, that under some circumstances a hydrid of ammonium, NH_4H, is capable of existence.

The passivity of iron has been studied from the standpoint of physical chemistry by Finkelstein. Determinations of its polarization

capacity and resistance indicate that there can be no coating of badly conducting oxid on the iron, as has been assumed by some observers. The conclusion is drawn that the surface of passive iron consists solely of trivalent iron, the formation of passive iron by oxidizing agents and by electrolysis being due to the replacement of bivalent by trivalent iron.

The subject of the action of water upon metallic lead is one that has been much studied, and the results of different observers have been by no means concordant. A recent extended investigation by Stanislav Růzička furnishes results which are not wholly in accordance with the generally received ideas. His method was to place bright lead in cylinders containing various solutions, insert a stopper and leave the whole for twenty-four hours. The amount of lead in the solution was then estimated. Care was taken to ensure the absence of air. Nitrates, chlorids, sulfates and carbonates of alkalies and alkaline earths were studied, and also various organic substances. Among his conclusions are the following: The action of salts is wholly independent of the base, and is proportionate to the solubility of the lead salt of the acid of the salt used. Thus nitrates have the most action, chlorids next, sulfates next and carbonates least. The action of the first-mentioned salts is diminished by the presence of carbonates in the water, while the addition of a nitrate increases the action of other salts. If the same piece of lead is exposed to fresh solutions of the carbonate, the action is much diminished, and the same diminution occurs even in the presence of nitrates and free oxygen. Free carbon dioxid greatly diminishes the action of water or salt solutions on lead, while air in all cases increases it. Infusions of grass leaves diminish the action of water, while it is greatly increased by infusion of peat.

A RECENT number of the *Mineralogical Magazine* contains a paper by J. W. Evans on the action of ground-water on pyrites, a study called forth by the building of a reservoir in northern Mysore. It was feared that the large quantity of pyrites in the underlying rock would act harmfully on the water. It was found that when the water was free from carbonates the pyrites are very slowly acted on with the formation of iron sulfate. On the other hand, when carbonates are present iron carbonate, hydroxids and oxids are to be expected, the hydrates being first formed. Free carbon dioxid in the water seems to be without effect. In the presence of pure water, metallic arsenids are changed into arsenates, which are generally insoluble, and the presence of carbonates has merely the effect of retarding the change.

IN an examination of Oriental medicines, P. Guigues had occasion to test a sample of 'Zerquoun minium,' which is used as a rather expensive substitute for the red oxid of mercury. The specimen resembled red lead, but had a lower specific gravity. On treatment with water a white sediment and a red solution were obtained. The former proved to be a magnesium silicate and the red substance a coal-tar dye, revealing the fact that adulterations are not peculiar to the Occident.

The above recalls the fact that the writer came into the possession some years ago of a specimen of Chinese medicine held in high esteem, which, it was supposed, was prepared from urine by some intricate method. Examination showed it to be ordinary salt, and of so pure a quality that it was hardly conceivable that it had been prepared from its reputed source.

J. L. H.

CURRENT NOTES ON METEOROLOGY.

MAURITIUS METEOROLOGICAL SOCIETY.

IT is a pleasure to note that the Meteorological Society of Mauritius has taken a new lease on life. This Society, with which the late Dr. Charles Meldrum was so closely associated, has in the past been active in promoting a study of the cyclones of the South Indian Ocean, to which study Meldrum devoted a large share of his time for about forty years. The successor of Dr. Meldrum as director of the Royal Alfred Observatory and also as secretary of the Meteorological Society of Mauritius, is Mr. T. F. Claxton, F.R.A.S., who is evidently doing much to arouse inter-

est in a society which the honored traditions of the past should most certainly keep alive and active. In the *Proceedings of the Meteorological Society of Mauritius* for 1901, Mr. Claxton has some 'Remarks on the Objects for which the Meteorological Society of Mauritius was Established.' In this paper it is shown that the work already accomplished has been most important, and the hope is expressed that the number of observing stations cooperating with the Royal Alfred Observatory may be increased. An unforeseen decrease in the number of vessels which call at the island of Mauritius has resulted in a corresponding decrease in the number of marine meteorological observations received by the Mauritius Observatory. The annual number of vessels has decreased from 787 in 1878 to 283 in 1900. The material for the daily weather maps is now so scanty that these charts have been discontinued except during cyclone weather, when they are useful for determining the tracks of cyclones. For giving a correct representation of the atmospheric conditions over the Indian Ocean, with a view to studying the sequence of weather changes, the charts are now well-nigh useless.

Vol. I. of a new series of the *Proceedings and Transactions of the Meteorological Society of Mauritius,* 1896–1900, has come to hand recently, and is welcome as a continuation of the older series, which was discontinued in 1864 for lack of funds and other reasons. This volume contains a number of interesting papers, chiefly on the cyclones of the South Indian Ocean from 1896 to 1900. A cyclone in February, 1896, passed centrally over Mauritius, this being the second case of this kind on record since the commencement of systematic observations in 1848. The diameter of the 'eye' was about twenty miles. Meteorologists will be glad to have in their hands these further contributions to the study of the Mauritius cyclones, and will not be slow to express their thanks to Mr. Claxton for his energy in continuing Meldrum's great work.

BRITISH RAINFALL.

The annual volume on 'British Rainfall' comes this year in its familiar blue cloth binding, but with a new name, that of Dr. Hugh Robert Mill, on its title page. As has already been reported in these 'Notes,' Mr. H. Sowerby Wallis succeeded to the editorship of this important publication after the death of Mr. George J. Symons in 1900. Mr. Wallis was associated with Mr. Symons for over thirty years, and from 1890 on his name appeared with that of Mr. Symons on the title-page of 'British Rainfall.' Dr. Mill, as already noted in these columns, has assumed the editorship of *Symons's Monthly Meteorological Magazine,* and is now associated with Mr. Wallis in carrying on the work of the British Rainfall Organization. The present volume is a particularly interesting one. Dr. Mill has a paper on 'The Ilkley Flood of July 12,' which was caused by an unusually heavy rainfall amounting to 5.40 in. at Ilkley itself (the maximum fall for the year in the British Isles); and another paper, of historic value, on 'The Development of Rainfall Measurement in the last Forty Years,' in which the material, size, form, exposure and elevation of rain gauges used in England are considered. It is a satisfaction to know that 'British Rainfall' is to be continued in such excellent hands.

CLIMATIC CONDITIONS OF PANAMA AND NICARAGUA.

In a recent paper on 'The Present Condition of the Panama Canal' (*Engineering Mag.,* January, 1902), Gen. H. L. Abbot considers briefly the climatic conditions of the Panama and Nicaragua canal routes. Throughout the entire region the temperature varies but little during the year from the annual mean of 79°. The high temperatures and high relative humidity forbid hard manual labor on the part of white men. The hospital records of the Panama Railroad and of the Canal Company during the past twenty years show that there is no reason for apprehending serious trouble from sickness in the future. At Colon the annual precipitation is about 129 inches, in the interior, about 94 inches, and on the Pacific coast, about 57 inches. There is a clearly defined dry season of about four months everywhere along the

route of the Panama canal. This season can be used for especially difficult engineering operations. Furthermore, the heaviest work is in the interior, where the rainfall is not excessive. The conditions are less favorable in Nicaragua. Near the Gulf coast, where the heaviest excavations are required, the rainfall appears to be about 250 inches and there is no dry season. On the Pacific coast and in the interior there is less rainfall, and there is also a dry season. Even here, however, the rainfall seems to be somewhat greater than in the corresponding portions of the Panama district.

DAY DARKNESS IN LONDON.

A SHORT article of some interest in *Symons's Monthly Meteorological Magazine* for January concerns the number of hours during which artificial light was necessary in a London office (J. E. Clark, 'Day Darkness in the City'). The record has been kept since September, 1897, and runs through 1901. Office hours were from 9 to 5, and to 1 P. M. on Saturdays. A curve illustrates the diurnal distribution of dark quarter hours. There is a rapid rise from 9 to 10.15; then a marked fall to just before noon; then a slight rise; a fall after 12:30 until just before 1; a rise till after 1 and a steady and marked rise from about 2 on. The first rise is believed to be associated with the lighting of office fires. The noon rise seems to follow luncheon preparations in the restaurants, and that an hour later is thought to be due to the fact that lunching is then in full swing. The results of these observations are not without interest, but the explanation of the facts discovered on the basis of so few records cannot be accepted as at all convincing. R. DEC. WARD.

SCIENTIFIC NOTES AND NEWS.

THE National Observatory question has assumed a new phase through the action of the secretary of the navy, in sending to Congress through the secretary of the treasury an estimate for the salary of a director of the naval (or national) observatory. The committees of Congress thus have the matter before them in a form in which it was never before presented, and it lies with Congress to decide whether it will accede to the recommendation.

PROFESSOR HERMON C. BUMPUS, formerly of Brown University, who has held during the past year the position of assistant to the president in the American Museum of Natural History, New York, was appointed director of the museum at the annual meeting of the board of trustees. This places the museum in the same position as regards administration as the Zoological Park and the Botanical Garden of New York. Morris K. Jesup was reelected president, William E. Dodge first vice-president, and Henry F. Osborn second vice-president.

PROFESSOR W. H. BREWER, for thirty-seven years professor of agriculture in the Sheffield Scientific School of Yale University, will retire from the active duties of the professorship at the end of the present academic year.

DR. J. KINYOUN, who has for fifteen years been connected with the U. S. Hospital Service and is at present commanding officer and chief surgeon of the hospital at Detroit, has resigned from the service.

MR. ALEXANDER AGASSIZ has had a portrait of himself painted by M. Jules Lefevre. The painting in which he is shown in the robe of members of the Paris Academy will be presented to Harvard University.

M. ANDRÉ, of Lyons, has been elected a correspondent of the Paris Academy of Sciences in the Section of Astronomy in the room of the late B. A. Gould.

THE Zoological Society of London will confer its gold medal on Sir Harry Johnston, whose remarkable discovery of the okapi has recently attracted so much attention, and its silver medal on Mr. E. W. Harper, of Calcutta, who has given many rare Indian birds to the society's collections.

SIR JOHN S. BURDON-SANDERSON, professor of physiology at Oxford University, has been given the degree of Doctor of Science by Owen's College, Manchester.

THE University of Jena has awarded and conferred an honorary doctorate on Herr Wilhelm Winckler, in recognition of his astronomical researches.

Dr. C. S. Belli, of Turin, has been appointed director of the Botanical Gardens at Cagliari.

Dr. A. A. Ivanov, assistant astronomer at Pulkova Observatory, has been appointed inspector in the St. Petersburg Institute of Weights and Measures and at the same time has been made docent in astronomy and geodesy at the University.

At the anniversary meeting of the Geological Society of London officers were elected as follows: President, Professor C. Lapworth, F.R.S.; Vice-Presidents, Sir Archibald Geikie, F.R.S., Mr. J. E. Marr, F.R.S., Professor H. A. Miers, F.R.S., and Professor H. G. Seeley, F.R.S.; Secretaries, Mr. R. S. Herries and Professor W. W. Watts; Foreign Secretary, Sir John Evans, F.R.S.; Treasurer, Dr. W. T. Blanford, F.R.S. The medals and funds were awarded in accordance with the announcement that we have already made.

M. Berthelot has been elected honorary president, and M. Moissan, president, of the council of the Chemical Society of Paris.

M. Teisserenc de Bort has made a visit to Denmark to establish a meteorological station in which kites and captive balloons will be used.

Professor Bessey, of the University of Nebraska, is to give a course of twenty lectures on botany in the Colorado Springs Summer School, which is to be held in Colorado Springs, Colo., in July and August.

Professor Volney M. Spalding, of the University of Michigan, is at present on a botanical expedition to Florida.

Major Ronald Ross, of the Liverpool School of Tropical Medicine, left Liverpool on February 22 for Sierra Leone to make an examination of the drainage scheme being carried out there, and to study the health of the natives.

The committee of the Medical School of the Johns Hopkins University, appointed to erect a memorial to the late Jesse William Lazear, who lost his life as the result of an experiment on the transmission of yellow fever by mosquitoes, reports that sufficient money has been subscribed to erect a memorial tablet and to establish a library fund for the purchase of works relating to tropical diseases. The committee now hope that a sufficient sum may be subscribed to establish a permanent scholarship for the study of tropical diseases. Subscriptions for this purpose may be sent to Dr. Stewart Paton, treasurer, 213 West Monument Street, Baltimore, Md.

Professor Leo Königsberger, of Heidelberg, is preparing an extended biography of Hermann von Helmholtz, which will be published by Friedrich Vieweg and Son.

The students of the University of California held memorial exercises in honor of the late Professor Joseph Le Conte on February 26, the anniversary of his birth. An address was made by Professor Thomas R. Bacon. The students of the university are collecting funds to assist in the erection of a granite lodge which the Sierra Club proposes to construct in the Yosemite Valley as a memorial to Dr. Le Conte.

Dr. Christian Penger, professor of clinical surgery in the Rush Medical College of the University of Chicago, died on March 7, at the age of fifty-two years.

We regret to record the following deaths among foreign men of science: Dr. Emil Holub, a distinguished African traveler, in Vienna on February 21, aged fifty-four years; Professor Moriz Kaposi, of the University of Vienna, well-known for his publications on diseases of the skin, on March 6, at the age of sixty-four years; Dr. Carlos Berg, director of the National Museum at Buenos Ayres, at the age of fifty-nine years; Dr. Johannis Pernet, professor of physics in the Polytechnic School at Zurich, at the age of fifty-seven years, and Captain Gaetano Casati, an Italian explorer who spent ten years in Africa, at the age of sixty-three years.

At the annual meeting of the Board of Managers of the New York Zoological Society it was reported that the society has contributed $250,000 towards the Zoological Park and has $18,000 in the treasury yet to expend, in addition to $17,000 which has been expended upon the plans and designs for the buildings. The City of New York has expended $425,000

in the general development of the park, and in the erection of a monkey house and lion house. The latter building will be open to the public in September next. During the past year a medical staff has been established in order to secure scientific treatment of the animals and to study the causes and prevention of diseases. This consists of Dr. Frank H. Miller, a veterinarian of European training; Dr. Howard Brooks, a well-known pathologist, and a laboratory assistant. A number of interesting facts have already been secured by this staff which will be reported later in SCIENCE. The Society has applied to the Board of Estimate and Apportionment for an additional sum of $500,000, to be expended in the development of the physical features of the park, in forestry, and also in the construction of additional buildings, especially the antelope house, ostrich house and a larger bird house.

As we have already announced, the seventy-second annual meeting of the British Association for the Advancement of Science will be held at Belfast, beginning on September 10. Professor James Dewar is the president-elect, and the presidents of the sections are as follows: Mathematical and Physical Science, Professor John Purser; Chemistry, Professor Edward Divers; Geology, Lieutenant-General C. A. McMahon; Zoology, Professor G. B. Howes; Geography, Col. Sir T. H. Holdich; Economic Science and Statistics, Mr. E. Cannan; Engineering, Professor John Perry; Anthropology, Professor A. C. Haddon; Physiology, Professor W. D. Halliburton; Botany, Professor J. Reynolds Green; Educational Science, Professor Henry E. Armstrong. Professor Dewar's presidential address will be given on the evening of September 10; on September 11 there will be a soirée; on the evening of September 13 a discourse on 'Becquerel Rays and Radio-Activity' will be delivered by Professor J. J. Thomson; a lecture will be given to the operative classes on September 14 by Professor L. C. Miall; on Monday evening, September 16, a discourse on inheritance will be delivered by Professor W. F. R. Weldon, M.A., F.R.S.; on Tuesday evening there will be a soirée; on Wednesday, September 18, the concluding general meeting will be held at 2:30 P.M.

LETTERS dated from Franz Josef Land, August 17, have been received at Copenhagen from members of the Baldwin-Ziegler Arctic expedition which left Tromsöe, Norway, on July 16, last year, on the steamers *America* and *Belgica*. The vessels arrived at Franz Josef Land, after trying experiences, with all on board well. The *America* intended to winter at Franz Josef Land, and then proceed northward until stopped by the ice, when the party on board of her was to start towards the North Pole. Mr. Baldwin hoped that the *America* would reach 83 degrees north.

AT a meeting of the Royal Geographical Society, on February 24, Sir Clements Markham, president, described the progress of the British Antarctic expedition and laid special stress on the need of securing sufficient money for the relief ship which is to be sent out in June. Subscriptions for this purpose include: The Royal Society, £500; the Goldsmiths' Company, £200; Mr. L. W. Longstaff, £5,000; Miss Dawson-Lambton, £500; Miss E. Dawson-Lambton, £500; Mr. J. P. Thomasson, £500; Lady Constance Barne, £150; the Duke of Bedford, £100; Sir E. Cassel, £100; Mr. H. Leonard, £100; Dr. G. B. Longstaff, £100; Mr. Duncan Mackinnon, £100; the Duke of Northumberland, £100; and Mr. S. Vaughan Morgan, £75.

THE Royal Astronomical Society has received from Sir William Huggins a copy of the portrait of Galileo at Florence, and from Sir W. J. Herschel, a medallion in Wedgwood ware of Sir William Herschell.

THE council of the Royal Institute of British Architects has granted the sum of £50 to the Cretan Exploration Fund towards the completion of Mr. Arthur Evans's excavations at Knossos. Since the appeal issued in December the sum of £1,600 has been raised.

UNIVERSITY AND EDUCATIONAL NEWS.

PRESIDENT HARPER announced in his last quarterly statement that Mr. John D. Rockefeller gave on December 1, $1,000,000 toward the general endowment fund of the University

of Chicago. Mr. Rockefeller has also given $250,000 to be used for the general needs of the University during the present academic year.

By the will of Mrs. Lila Currier, $50,000 will go to Columbia University and $100,000 to Yale University upon the death of Mr. Edward W. Currier.

By the opinion just handed down by the Supreme Court of Pennsylvania affirming the opinion of the Orphans' Court of Philadelphia, which sustained the will of the late Joseph M. Bennett, the University of Pennsylvania acquires real estate declared to be worth more than $500,000. The decedent left the property to the University 'to further aid and encourage the trustees in carrying out more practically and thoroughly the coeducation of women and girls.'

The daily papers renew the reports that negotiations are under way for the amalgamation of the Armour Institute of Technology with the University of Chicago. The plan involves the removal of the Institute to the University campus, where the University will furnish buildings and equipment to the value of $1,000,000, while the Armour interests will give $1,500,000 in endowment. Subsequent gifts from the Armours and Mr. Rockefeller are expected to increase the capital of the technology school to $5,000,000. The school will continue to be known as the Armour Institute of Technology, its policy will be maintained, and the heads of departments will remain practically the same.

Columbia University has received an anonymous gift of $10,000 for two scholarships, and one thousand dollars for a course of biological lectures.

Mr. William Johnston, a Liverpool shipowner, has given £25,000 to the University of Liverpool, to promote research in pathology and physiology.

A chapter of the scientific honor society Sigma Xi has been organized at the University of California with twenty members of the faculty as charter members.

The registration at the University of Chicago for the autumn quarter was 2,431, as compared with 1,961 in 1900 and 1,682 in 1899. The number of students in the graduate schools was 435, of whom 197 were in the Ogden school of science. In the school of arts and literature the numbers of men and women were equal, in the school of science there were 170 men and 27 women.

The new laboratory building of the department of horticulture of the Iowa State College was formally opened on Saturday evening, February 22.

Cablegrams report that in the disturbances on February 22, at Moscow University, four hundred students, armed with bludgeons, iron bars and revolvers, wrecked the interior of the University buildings, barricaded themselves within, and hung out red flags from the windows. The police and troops forced an entrance into the interior and arrested the ringleaders of the rioters. A decree of the minister of public instruction has been gazetted, ordering the expulsion from the University and high schools of all students arrested in connection with rioting.

Professor F. J. E. Woodbridge, now head of the department of philosophy in the University of Minnesota, has been elected to the chair of philosophy at Columbia University vacant by the election of Dr. Nicholas Murray Butler to the presidency.

Dr. George E. de Schweinitz, professor of ophthalmology in the Jefferson Medical College, has been elected to succeed the late Dr. Norris as professor of ophthalmology in the University of Pennsylvania.

Dr. K. von Tubeuf, chief of the biological division the German Department of Health, has been appointed professor of forestry in the University of Munich.

ERRATA.

The following errors were overlooked in the proof of Professor Greenhill's paper (Science, XIV., p. 973, 1902): Eq. (1), for x read ψ p. 3, line 13, for δ read ϑ; eq. (19), for k read κ; eq. (28), for z^2 read z_2 and for $E-2$ read $E-z$; eq. (32) *et seq.*, for μ and v read u; eq. (40), for n read u.